THE

PRACTICAL MECHANIC'S JOURNAL.

VOLUME IV.

APRIL, 1851——MARCH, 1852.

"Boyle has entitled one of his essays thus remarkably—'*Of man's great ignorance* of the uses of natural things; or that there is no one thing in nature whereof the uses to human life are yet thoroughly understood.' The whole history of the arts, since Boyle's time, has been one continued comment upon this text."

"When we look back at what has been accomplished in science, and compare it with what remains to be done, it is hardly possible to avoid being strongly impressed with the idea, that we have been, and are still, executing the labour by which succeeding generations are to profit. Science, in relation to our faculties, still remains boundless and unexplored; and after the lapse of a century and a half from the era of Newton's discoveries, during which every department of it has been cultivated with a zeal and energy which have assuredly met their full return, we remain in the situation in which he figured himself—standing on the shore of a wide ocean, from whose beach we may have culled some of those innumerable beautiful productions it casts up with lavish prodigality, but whose acquisition can be regarded as no diminution of the treasures that remain."—SIR JOHN HERSCHEL.

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AND BINDER'S DIRECTIONS.

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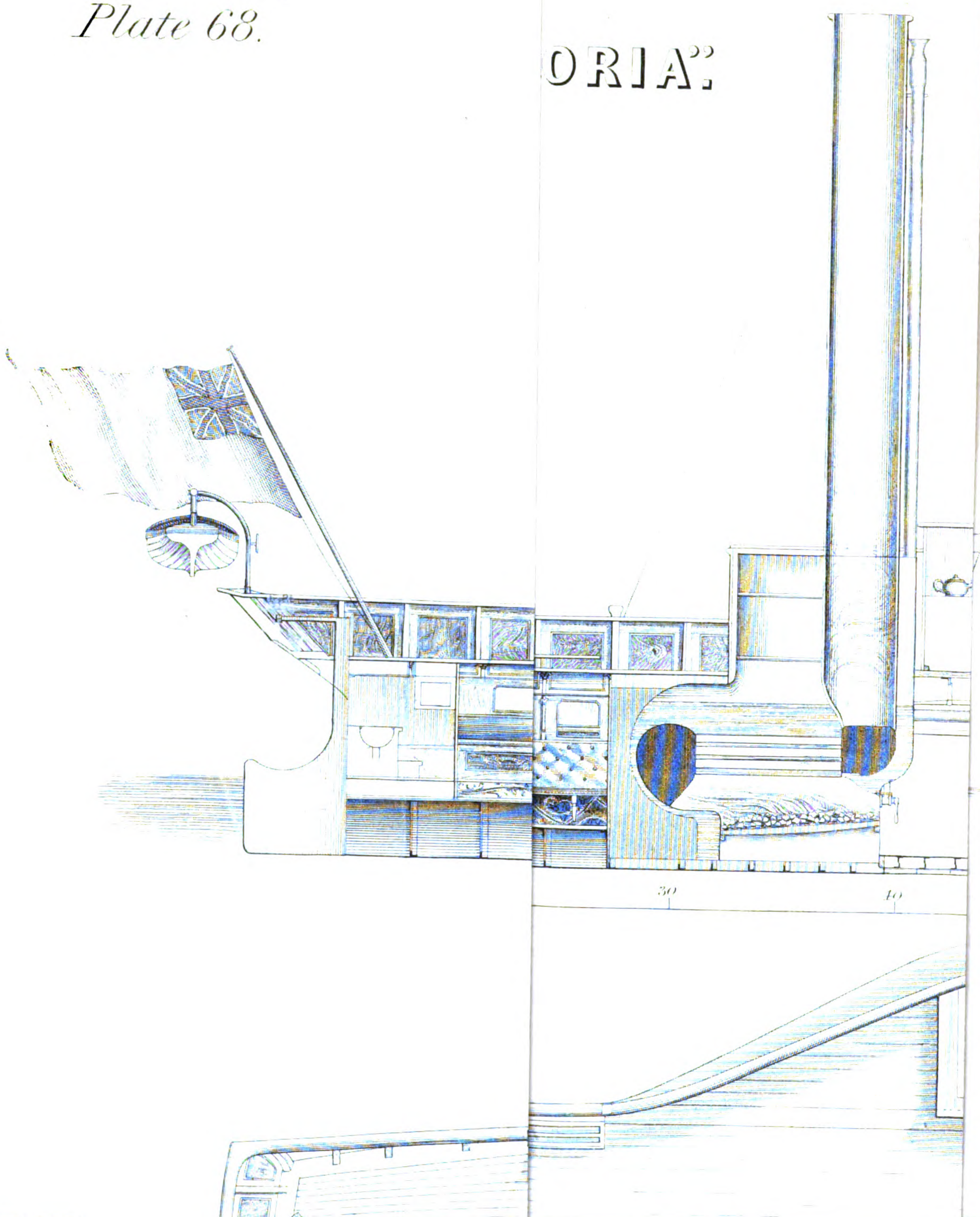


THE

PRACTICAL MECHANIC'S

JOURNAL.

THE RIVER STEAMER "VICTORIA."

ROBERT NAPIER, ESQ., ENGINEER.

(Illustrated by Plate 68.)

THE iron steamer "Victoria" is one of the most successful of the modern class of the fast river-boats for which the Clyde has become so famous. She was built for the Glasgow and Gairlochead station, and was launched on the 20th of May, 1850, since which time she has been in constant work, with a success which warrants us in according to her the position which we have named. Our plate 68 represents her in two views. The upper one on the sheet is a sheer draught, showing her in vertical longitudinal section. The lower view is a corresponding plan, one-half from bow to stern being shown, with the deck removed, to give a clear view of her fore and aft cabins, and other details. The following are her principal—

DIMENSIONS.

Length on deck, from fore-part of stem to after-part of stern-post,......	154 feet 6 inches.
Breadth amidships, outside,......	16 " $\frac{1}{2}$ "
Depth amidships, from under-side of deck to bottom of frames,......	8 " 7 "
Ordinary draft of water, ...	3 " 9 "
Length of corresponding water-line section, ...	148 " 0 "
Area " " " " " "	about ...1730 square feet.
Frictional surface, ...	" ...2200 "
Immerged midship sectional area, ...	" ... 50 "
Displacement, ...	" ... 137 tons.
Gross tonnage "old measurement,"	196·6 tons.
" " new measurement,"	112·3 "
" of engine and boiler space, ...	45·8 "
Register tonnage, ...	66·5 "

Keel—Of 3 × 3 × $\frac{3}{8}$ inch angle-iron, in one length.

Stem—Of $2\frac{1}{2}$ × $\frac{5}{8}$ inch bar-iron.

Stern Post—Of $\frac{3}{8}$ inch plate, 12 inches broad at top, tapering to 4 inches at bottom.

Frames—For 75 feet amidships of $2\frac{1}{2}$ × $2\frac{1}{2}$ × $\frac{1}{4}$ inch angle-iron, fore and aft of 2 × 2 × $\frac{1}{4}$ ir angle-iron, spaced 3 feet apart from stem to stern, and on each verse frame of 2 × 2 × $\frac{1}{4}$ inch angle-iron, carried to within 18 i s of the gunwale.

In engine and boiler spa ntermediate frames of the same strength as the others, but car d only to the bilges.

Floors—Of $\frac{3}{16}$ inch plates; in boiler space 6 inches deep, and in engine space 17 inches, with the reverse frame carried along their upper edge. Forward and aft there are no plates, and the reverse frames are carried across at the height of the cabin soles.

Deck Beams—In engine and boiler space of 3 × $2\frac{1}{2}$ × $\frac{3}{8}$ inch angle-iron; fore and aft of 3 × 2 × $\frac{1}{4}$ inch angle-iron on every frame; and attached thereto with 12 inch knees, formed of $\frac{3}{16}$ inch plate.

	For 63 feet Amidships.	Fore and Aft.
Plating—Keel strake,......	$\frac{1}{4}$ inch plates,	$\frac{3}{16}$ inch plates.
Remainder of bottom,	$\frac{3}{16}$ "	$\frac{3}{16}$ "
Bilge and topsides,...	$\frac{3}{16}$ "	$\frac{1}{8}$ "
Counter,......	$\frac{3}{16}$ "	

Bulkheads—One forward, another aft of engine and boiler space, and a third between the fore cabin and steerage, formed of $\frac{3}{16}$ inch plates, stiffened with 3 × 3 × $\frac{3}{8}$ inch angle-iron every 30 inches.

Coal Bunkers—Of $\frac{1}{8}$ inch plate, stiffened with $1\frac{3}{4}$ inch angle-iron.

Paddle Beams—Of $\frac{3}{8}$ inch plate, 8 inches deep, with 3 × $2\frac{1}{2}$ × $\frac{3}{8}$ inch angle-iron along the upper edge.

Engine Beams—Formed of two $\frac{3}{8}$ inch plates, 16 inches broad, set at right angles to one another with $2\frac{1}{2}$ × $2\frac{1}{2}$ × $\frac{3}{8}$ inch angle-iron placed in the angle; also further connected by knees of $\frac{3}{8}$ inch plate, attached to the beam plates with $2\frac{1}{2}$ × $2\frac{1}{2}$ × $\frac{3}{8}$ inch angle-iron.

Plummer Block Seats—Attached to outside of vessel, framed with 6 × 3 × $\frac{1}{2}$ inch, and 3 × 3 × $\frac{3}{8}$ inch angle-iron, and plated on top with $\frac{1}{2}$ inch, and on remainder with $\frac{3}{8}$ inch plates.

Wing Wales—Of $\frac{3}{16}$ inch plates, 38 inches deep, stiffened with $2\frac{1}{2}$ × $2\frac{1}{2}$ × $\frac{3}{8}$ inch angle-iron, and on outside by a belting formed of $\frac{3}{8}$ inch plates, bent on the crown to a radius of $3\frac{1}{2}$ inches, and projecting 12 inches from the wing wales, to which they are attached by 3 × 3 × $\frac{3}{8}$ inch angle-iron, riveted along its edges.

Wing Carlings—Formed of $\frac{5}{16}$ inch plate, with $2 \times 2 \times \frac{1}{4}$ inch angle-iron along their edges, knee'd to the vessel's side, and rounded on the outer ends to receive the belting plate on the wing wales, which is continued along the wings.

Gunwale Stringer—Of $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$ inch angle-iron, riveted to outside from fore-part of wing aft to the stern, and on inside in the remainder of the vessel; also, for 47 feet amidships; a $\frac{3}{8}$ inch stringer plate 15 inches broad.

Bilge Keels—On each bilge, for about 80 feet amidships, formed of $\frac{1}{4}$ inch plates, bent to a radius of 2 inches, and projecting 5 inches from the plating of the vessel, to which they are attached by $2 \times 2 \times \frac{1}{4}$ inch angle-iron, riveted along their edges.

Rudder—Stock formed of a round tube $\frac{1}{2}$ inch thick, and $7\frac{1}{2}$ inches in diameter, plated with $\frac{3}{16}$ and $\frac{1}{4}$ inch plates.

WOOD WORK.

Stanchions—Of British oak, larch, and red pine. Paddle-boxes 4×3; bulwark ditto, $3 \times 3\frac{1}{2}$, 3 feet high; quarter timbers, British oak, 7×6; stern timber, larch, 5×4; fore gangway stanchions, 5 inches square. Timber-heads, 2 aft on quarter deck, 6 inches square; 2 at gangway aft, 7 inches square; 2 at gangway forward, 6 inches square; cleading of bulwarks and sides of paddle-boxes, 1 inch, yellow pine; tops of paddle-boxes, 2 inches, yellow pine; stern plank, 2 inches, yellow pine.

Rails—Of elm, 6×2; paddle-box rims, of elm, $4 \times 2\frac{1}{2}$.

Covering Boards—Of red pine, $12 \times 2\frac{1}{2}$.

Deck Plank—From stern to midships, 5×2 inches, yellow pine; from midships forward, of memel, 7×2; cabin soles, fore and aft, elm, $1\frac{1}{4}$ thick; bearers for cabin sole, 2 inches square, bolted to reverse angle-iron.

She was built from the designs of Mr. J. R. Napier, who has distinguished himself by the production of a great many justly-celebrated Clyde vessels—among which may be named the well-known sea-going steamer "Thetis," of the Glasgow and Belfast station. She is fitted with a pair of oscillating engines, and has feathering paddles. Her speed, on a trial at the measured mile in the Gairloch, was 16·9 miles an hour, the mile being performed in 3 minutes and 33 seconds. This rate is, we believe, at least a mile an hour faster than that of any other of the Clyde boats.

We shall next month give some additional large plates of her engines and boilers, with complete details.

PHYSICAL GEOGRAPHY.

No. IV.

Mountain Systems.—The protuberances of the earth's surface are scattered over it in isolated mountains, in groups, and in chains. The chains sometimes consist of several lines, connected, but having different directions; at others, of single lines, with determinate courses. No general law has hitherto been discovered governing the distribution of mountains with respect to one another, or with respect to the surrounding land. In some regions they are found associated in great numbers; in others they are wanting altogether, and many thousands of square miles are perfectly level plains. Sometimes they are parallel with the longest axis of a country; at others, at right angles to it. In America, the grand chains are close to and parallel with one of the coasts, from which they rise with great abruptness; whilst the other coast is several thousand miles distant, at the termination of a tolerably gradual slope. Isolated mountains are usually of volcanic origin.

The part performed by mountains in the economy of the globe is very various. Much falls within the province of meteorology to describe; but it may be here noticed, that they form, as it were, the bonework of continents, determining the courses of their aqueous veins, and marking out the boundaries of their river basins.

Elie de Beaumont, a French geologist, has attempted to show that all parallel mountain chains were of contemporaneous origin. He is of opinion that the history of the earth is marked out into long periods of comparative repose, by short periods of paroxysmal violence; and that sedimentary matter was regularly and continuously deposited during the former period, until the deposition was interrupted by the recurrence of violence. He thinks that mountain chains were thrown up during the paroxysmal periods, and that the passage from one sedimentary formation to another occurred at these times, the organic types being then considerably altered. That this theory is opposed by Sir Charles Lyell, we need not state to such of our readers as perused our recent article, describing in outline the conclusions of the latter geologist. Nevertheless, M. de Beaumont has pointed out, in support of his views, twelve European systems of mountains, corresponding, as he alleges, to as many paroxysmal movements of upheaval, and to twelve intervals in the series of stratified rocks. We cannot now go farther into the question, since its discussion would lead us away from Physical Geography to the grander science of Geology.

The following table exhibits a synoptical view of the chief mountain ranges and groups of the world:—

EUROPE.

Systems.	Length in miles.	Extreme Breadth in miles.	Mean Height in feet.	Area of Base in sq. miles.	Highest Point in feet.
Pyrenean chain	270	60	7,900	1,720	Maladi Ha, 11,168.
Peninsular System, Spain and Portugal—					
Austurian & Biscayan chain	...	...	...	...	Sierra de Penaranda, [11,000
Guadarama chain	...	...	...	...	Sierra de Gredos, 10,548
Sierra de Toledo					
Sierra Morena	...	...	3–4,000	...	....
Sierra Nevada	100	50	...	...	Pico de Mulhaçen, 11,666
French Mountains—					
Cevennes	...	...	...	...	Mount Mezen, 5,820
Auvergne (volcanic)	...	...	...	...	Pic de Sancy, 6,224
Vosges	170	40	...	...	Ballon de Sultz, 4,695
Jura	190	...	3,000	...	Mount Reculet, 5,628
Alps, from Gulf of Genoa to Great Glockner	420	150	7,690	...	Mont Blanc, 15,760
Gt. Glock. to Belgrade	600	200	...	...	Gt. Glockner, 12,776
Apennines	650	...	...	...	Monte Corno, 9,523
German Mountains—					
Bohemian System—					
Böhmerwald	112	M. W. 16*	...	...	Heidelberg, 4,620
Erzgebirge	100	M. W. 30	...	...	Keilberg, 4,200
Riesengebirge } Sudetengebirge }	130	M. W. 35	...	...	Schneekopfe, 5,320
Moravian Mountains	160	...	...	...	Glat. Schneeberg, 4,780
Central System—					
Fichtelgebirge	35	M. W. 28	...	900	Schneeberg, 3,420
Thüringerwald	70	M. W. 11	2,500	...	Beerberg, 3,300
Röngebirge	24	M. W. 5	2,000	...	Kreuzberg, 3,000
Spessart	24	M. W. 10	...	...	Geiersberg, 2,000
Harz	55	M. W. 18	...	800	Brocken, 3,740
Rhenish System—					
Odenwald	35	M. W. 25	...	..	Katzerbuckel, 2,320
Schwarzwald	145	25–40	...	...	Feldberg, 4,900
Carpathian Mountains	800	240	3–4,000	90,000	Lomnitz, 8,779
Balkan range, Turkey	600	...	...	...	Tschar Dagh, 10,000
Scandinavian Mountains	1,000	...	...	...	Snœhattan, 8,120

ASIA.

Systems.	Length in miles.	Extreme Breadth in miles.	Mean Height in feet.	Area of Base in sq. miles.	Highest Point in feet.
Caucasus	700	120	...	56,000	Elburz, 17,796
Ural Mountains	1,300	100	...	...	Konjakofski Kamen, [5,397
Elburz, Persia	...	...	...	...	Demavend, 14,695
Systems of Central Asia (4 nearly parallel ranges trending E. and W.)—					
Altai	4,000	700	...	...	Altai Bielhi, 11,500
Thian-shan, or Celestials	...	...	...	...	....
Kuen Lun	...	...	...	...	....
Himalaya	1,900	M. W. 90	15,670	160,000	Kunchinginga, 28,176
Mountains of Hindostan—					
Western Ghauts of Malabar	800	...	5,000–5,400	...	....
Eastern Ghauts of Coromandel	...	...	...	...	....
Nilgherries, or Blue Mountains	...	...	...	...	9,941
Australia—					
Alps of New S. Wales	1,500	...	...	...	Mount Kosciusko, 6,500

* M.W. = Mean width.

AMERICA.

Systems.	Length in miles.	Extreme Breadth in miles.	Mean Height in feet.	Area of Base in sq. miles.	Highest Point in feet.
North America—					
Western System—					
1. Cordillera of Mexico and Rocky Mountains	4,600	...	...	..	Pocatepetl (vol.), 17,700
2. Californian Maritime Alps and N. W. Coast range	4,600	...	...	...	Mount St. Elias, 16,770
Eastern, or Appalachian System — (numerous parallel chains, Blue ridge, Alleghanies—mean height, 2,500—Catskill Mountains, &c.)	1,200	150	...	2,000,000	Mt. Washington, 6,634
Central America—					
Group of Costa Rica	...	...	...	...	9,000
Group of Honduras & Nicaragua	...	...	...	...	....
Group of Guatemala	...	...	...	...	Agua, 15,000
South America—					
Western Systems—	4,500	...	...	...	....
Andes of Quito, from 8° N. to 5° S.	...	...		...	Chimborazo, 21,420
Andes of Peru, from 5° S. to 15° S.	...	...		...	Nevado de la Vinda, 16,000
Peru-Bolivian Andes, from 15° S. to 21° S., two chains	...	...	15,250	...	Sahama, 22,350
Andes of Chili, from 21° S. to 42° S.	...	...		...	Aconcagua, 24,000
Patagonian Andes	...	30		...	Yanteles, 8,030
North-Eastern Systems					
Panine ranges	1,200	...	...	...	Duida, 8,300
Venezuelan ranges	...	...	...	400,000	Silla de Caraccas, 8,600
Brazilian System	...	...	3,800	76,000	Itambe, 8,426

Coral Reefs.—The buildings of the coral animal, which are silently proceeding upon such an extensive scale in the zone included between 24° of latitude on each side of the equator, have recently been the subject of careful examination at the hands of various naturalists. They have been divided into three classes, viz., atolls, barrier reefs, and shore or fringing reefs. An atoll is a circular or elliptical-shaped wall of dead coral, washed up by the waves to the height of from 6 to 12 feet, enclosing a portion of the ocean, to which the name of lagoon is given. The bottom of the interior is cup-shaped, and the depth of the water varies from 20 to 50 fathoms. The living coral is at work beneath the surface, but the limit of its existence seems not to be deeper than 30 fathoms. The outer edge of the ring shelves rapidly downwards to a depth of perhaps 25 fathoms, and then the deep water commences all at once. At the distance of 2,000 yards from keeling-atoll, no soundings were found with a line of 1,200 fathoms. Atolls are more frequently oval than circular, and are more frequently arranged in a long stretching chain, or archipelago, than found solitary, or in groups. Their diameter varies from two to ninety miles. The sea beats their windward side with great fury, whilst the sheet of water within is perfectly calm. In the Pacific, Dangerous Archipelago is one of the largest collection of atolls. It consists of eighty, many of which are inhabited. The beating of the surf upon them may be heard at the distance of many miles. The largest collection, however, is that called the Caroline Archipelago. Its sixty groups of atolls extend 1,000 miles from one extremity to the other. The Maldive Archipelago is 470 miles long, and 50 wide; the Laccadive is formed by a double line of round atolls to the north of the former. The Chagos bank, a continuation of the Maldive and Laccadive lines, is an immense atoll, 90 geographical miles long by 70 broad, enclosing a lagoon which has nowhere a greater depth than 40 fathoms, whilst on the outside, only half a mile from the reef, no bottom was found with a line of 190 fathoms.

When an island occupies the middle of a lagoon, the coral edifice is termed an encircling reef. A moat of still water, from 2 to 5 miles broad, separates the land from the reef, which thus resembles the outer wall of a fortified place, protecting the interior from the assaults of the ocean. Openings in the ring here and there afford access to the lagoon. Otaheite is an encircled island of this description. *Barrier reefs* are those which extend in a linear direction, protecting a long stretch of land. A reef of this kind, 1,200 miles in length, stands 20 or 30 miles from the north-east coast of Australia, and stretches almost across Torres Straits. In places it is a mile across; the sea between and the shore is from 10 to 60 fathoms deep. There is another reef, 400 miles long, off New Caledonia. *Shore or fringing reefs* enclose no lagoons, but are built upon the edge of the shore itself, which they render dangerous for vessels.

It appears that we are not to regard the habitations of the coral animal as something entirely distinct from the animal itself. Those habitations are formed out of thin layers of carbonate of lime, elaborated by the vital functions of the animal; and each trunk or mass is a whole, which increases by means of buds, formed according to certain laws, a number of organically distinct individuals constituting the parts of which the whole consists. The individuals are unable to detach themselves at pleasure, because they are united to each other by the calcareous lamellæ, but there is no central point of common vitality. The polypi which thus build by budding, are madrepores, astræids, and ocellinæ. The coral they construct is adorned with many beautiful tints. The animal which works inside an atoll, is of a more delicate kind than that working on the outside, exposed to all the violent fluctuations of the ocean. Fish and turtle are fond of, and feed upon, the living gelatinous coral.

It has hitherto remained unexplained, why there should be so large a development of coral structures in some regions of the globe, whilst there are other regions, seeming to be equally well adapted for the animal, where they are entirely absent.

Waves.—Whenever the equilibrium of the particles of a fluid is disturbed, a wave is produced. Sea waves are produced by the attraction of the sun and moon, and by the wind. The first kind of waves form what is commonly called the tide. They are an example of those waves, termed waves of oscillation, or of the first order, in which, although the movement seems to carry a body of superficial water along with it, yet the fact is, that each particle has merely small oscillating motions in horizontal and vertical directions, so that, whilst the undulation moves onward, the particles, after rising and falling, return to their place. Each undulation has a phase of elevation, and a phase of depression. When a serpentine motion is given to a rope by the hand holding one end of it, we have an example of undulatory movements. The other kind of wave is called a wave of translation, or of the second order. Such a wave may be seen when a wave of oscillation approaches land. The lower part of such a wave being retarded by the shallow ground, the summit falls forward, and sends a body of water on shore. Here there is a real advancing movement in the water.

Waves have usually a cycloidal form, with summits of a gentle curvature. The height is small in proportion to the length; when the height increases, the summit becomes more acute, and the ridge, losing its equilibrium under the force of the wind, breaks into foam.

The changing force and direction of a gentle wind, produces those thousand varieties on the surface of water which are so delightful to the eye. The scene, however, is totally altered when the wind increases to a tempest. The waves swell upwards to an appalling height, and move onwards, in long files, with tremendous force. The eye, however, exaggerates the size of objects under such circumstances; and we must reduce the mountains, of which sailors have been wont to speak, to the apparently contemptible height of 20 feet above the mean level of the ocean, which very few waves, when exactly measured, are found to exceed. Captain Stanley, after many observations, never saw waves higher than 22 feet above the sea's level. During a hard gale, which occurred in a voyage across the Atlantic in 1848, Dr. Scoresby observed that the mean highest waves, not including the broken or accuminated crests, were about 43 feet above the bottom of the hollow; that the mean time elapsing between wave and wave was 16·5 seconds; and that the mean distance from wave to wave was 790·5 feet; so that the speed at which they travelled was about 32½ statute miles per hour. In respect to the form of waves generally, the inequality of the operation of the wind causes endless variety. If the wind were uniform in force and direction for some length of time, wide and deep sea waves of perfectly regular formation might be caused. But the wind is perpetually changing both its force and direction within certain limits, and thus many modifications take place.

What is called a *ground swell* is the commotion produced in the ocean by a violent storm in some remote part, perhaps a thousand miles distant.

The force with which waves, impelled by a strong wind, impinge upon any obstacle to their progress is very great. From the observations of Mr. Stevenson, made at the Bell Rock and Skerryvore Lighthouses, it appears that the waves of the German ocean struck against the one with a force of 1½ tons per square foot, whilst those of the Atlantic ocean struck the other with a force of 3 tons per square foot. There is no reason to suppose that the sea is agitated, even in the most violent storms, to a depth which is much below the surface; probably the commotion is not felt at a depth of 300 feet.

Botanical Geography.—One of the most remarkable facts which have been established by modern investigation is, that different regions are inhabited by totally distinct species, both of animals and plants. This diversity cannot be altogether ascribed to diversities of climate,

since analogical climates have frequently no identity of productions. There is a sensible difference between the plants of the tropical regions of America, Asia, and the west coast of Africa. It is true that vegetable existence gradually increases in vigour and in variety of form from the poles to the equator, and that the structure of some plants demands a warm dry atmosphere, that of others a cool moist one; but how does it happen, inquires Humboldt, that Africa has no laurineæ, nor America any heaths—what is the reason that not one of the melastoma family grows north of the parallel of 30°, and that no rose-tree belongs to the southern hemisphere? Decandolle affirms that it would not be difficult to find two points, one in North America, and the other in Europe; or one in equinoctial America, and the other in Africa, presenting similar circumstances as regards temperature, humidity, and height above the sea, and yet nearly all the plants in the two localities shall be distinct. A degree of analogy in aspect and structure may possibly be discovered, but the species would in general be different. For instance, out of 2,891 phenogamous plants, described by a botanical writer as growing in the United States, only 385 are found in northern or temperate Europe. Out of 4,100 species discovered in New Holland, no more than 166 grow in Europe, nearly all of which are cryptogamic.

Moreover, this diversity in specific character takes place with respect to the vegetation of widely-separated parts of the same continent. The distinctness of the groups of indigenous plants (says Lyell), in the same parallel of latitude, is greatest where continents are disjoined by a wide expanse of ocean. In the northern hemisphere, near the pole, where the extremities of Europe, Asia, and America approach near to one another, a considerable number of the same species of plants are found common to the three continents. It is a general rule, that plants found at two points very remote from each other occur also in places intermediate.

The number of plants upon islands which are remote from continents is altogether small; but the bulk of the species is peculiar, the remainder being identical with those of the nearest continents. For example, out of 533 phenogamous plants found at the Canary islands, 310 are peculiar, and the rest are identical with African plants. Of 30 species of phenogamous plants indigenous at St. Helena, not more than two have been met with elsewhere. The flora of the Galapagos group is very singular; 185 flowering plants have been discovered upon the ten principal islands which lie in 1° south latitude, about 600 miles distant from the Pacific coast of America, and 100 of them are new species. The type of this flora is stated to be related to that of the western coast of America, and to have no affinity with the other islands of the Pacific.

These facts have given rise to the idea, that there were originally foci or centres of creation, whence plants had a tendency to spread on all sides, and that the history of the vegetable covering of our planet, and its gradual propagation over the desert crust of the earth, had (in the language of Humboldt) its epochs as well as that of the migrations of the animal world. A high mountainous range, existing anterior to the creation of a group of species, would form a barrier to the dissemination of these species; but if such a range was elevated after a particular group had been called into existence, it would assist in spreading the species, and form a new centre of radiation. Hence, although some plants have been so diffused that they may be found in almost all parts of the globe, botanists are able to mark out the limits of distinct assemblages of species, and to divide the land into provinces, characterised by peculiar vegetation. Decandolle describes twenty of such provinces, which Martius increased to 51. The specific identity to any extent (says Professor Forbes) of the flora and fauna of one area with those of another, depends on both areas forming, or having formed, part in the same specific centre, or on their having derived their animal and vegetable population by transmission, through migration, over continuous or closely contiguous land, aided, in the case of alpine floras, by transportation on floating masses of ice.

Setting out from the theory of distinct centres of creation, Professor Forbes proposes to account for the frequent separation of assemblages of plants from the main body by considerable intervals, by supposing that the isolated areas were once connected with their centres, and that the severance was brought about by geological causes, especially those connected with the elevation and depression of the land. In illustration of this view, he asserts that the plants of the British islands belong to five distinct floras:—1st. A flora confined to the west of Ireland, and mostly to the mountains of that district. This is quite distinct as a system from the floras of the Scottish and Welsh mountains. It has a marked southern character, and so strongly resembles the flora of the Pyrenees, that its origin is supposed to date from that remote period when a great range of mountains stretched across the Atlantic, and connected Ireland with Spain. 2d. A flora, extending from the Channel islands across Devon and Cornwall to the south-east of Ireland, is related to that of the south-west of France. Traces of the connection which formerly existed between these parts of England and France, are afforded by the islands lying between them. 3d. The flora of the south-east of England, especially developed in the chalk districts, is closely related to that of the north of France. Geologists have been long impressed with the belief, that the English and French coasts were once united at this point, and they grounded their opinion on the identity of the strata. 4th. An Alpine flora, developed on the mountains of Wales, the north of England and Scotland; this is intimately related to the flora of the Norwegian Alps. 5th. A flora embracing the mass of British plants, surrounding and intermingling with the other floras. There are indications that this is related to the flora of Northern Germany. The fourth flora is thought to have originated when the mountain summits of Britain formed part of a chain of islands that stretched through a glacial sea to Norway. As these islands were slowly upheaved, the arctic vegetation was driven by the change of climate to seek the tops of the mountains. The rising of the bed of this sea laid bare a great plain that connected England with Germany, and hence the relation of the fifth flora to that of Northern Germany.

There are several obscure points connected with this subject, of which no satisfactory explanation has yet been given. Amongst them may be numbered the fact, that some few plants are common to countries very far apart, whilst the intermediate regions afford no clue by which the transmission can be traced. For instance, the Samolus Valerandi, a plant common in Great Britain, is also found in Australia. Again, some plants are strictly limited to one particular spot—thus the Cedar of Lebanon is indigenous solely on that mountain; and there is a species of pine, the Pinus Canariensis, which has only been met with at the Canaries.

In the inorganic crust of the earth we perceive no dependence of form upon climatic influences, but in the vegetable creation it is very different; every zone has its distinctive character and its peculiar beauties. In the tropics are found variety and grandeur of form; in the north, quiet meadows and pastures. Humboldt says that each region of the earth has a natural physiognomy peculiar to itself, and he enumerates sixteen different forms as principally concerned in determining the aspect of nature. An exact enumeration, according to physiognomic diversity, is, he admits, not capable of being obtained. The groups, or classes, named (which sometimes embrace plants which have no natural connection but that of external aspect), are Palms (440 known species), Plantains or Bananas, Malvaceous plants, Mimosas, Heaths, Cacti, Orchids, Casuarinæ, Needle-leaved trees (Coniferæ, Cypresses, &c.), Pothos-formed plants (including the Aroideæ), Lianes or Rope plants, Aloes, Grasses, Ferns, Liliaceous plants, Willows, Myrtles, and Laurels.

The same writer gives a short series of cultivated plants, placed in order of succession according to the degree of heat they require, beginning with the maximum: Cacao, Indigo, Plantains, Coffee, Cotton, Date Palms, Orange and Lemon trees, Olives, Sweet Chesnuts, and Vines.

The south polar ocean abounds in a very peculiar and minute kind of vegetation. Ehrenberg, after examining specimens with the microscope, pronounced these *diatomaceæ* to be animalcules; but Dr. Hooker is of opinion that they are plants. He found them in the stomachs of various molluscæ throughout nearly 100° of lat., viz., from the north tropic to Victoria barrier. Within the Antarctic Circle they are found enclosed in newly-formed ice, and being washed up by the sea on to the pack and bergs, they stain the white snow and ice a pale ochreous brown. Some specimens are found in various sedimentary rocks, tripoli stone, phonolites, and volcanic ashes; and there is a deposit of mud flanking Victoria land, 400 miles long by 120 broad, and at a depth of between 200 and 400 feet, which is chiefly composed of the siliceous shells of the Diatomaceæ.

Marine Vegetation.—The vegetation of the sea is susceptible of division, like that of the land, into distinct provinces; they are much fewer in number, however, both on account of the greater uniformity of temperature, and the greater facilities of dispersion. Vegetation terminates where the light ceases to penetrate, and consequently the limit of the lowest zone depends on the transparency of the water, whilst the highest zone lies between high and low water-mark. In our seas there are only two flower-bearing seaweeds, the Zostera and Zanichellia, the rest is cryptogamic. The second British zone, commencing at low water-mark, extends to a depth varying from 7 to 15 fathoms. Dr. Joseph Hooker has determined the ten following provinces of marine vegetation, admitting, however, that there are several others with which we are imperfectly acquainted:—The North Circumpolar, the North Atlantic, the Mediterranean, the Tropical Atlantic, the South Atlantic, the Antarctic American, the Australian and New Zealand, the Indian Ocean and Red Sea, and the Chinese and Japanese Seas.

Seaweed, torn up from its bed, is often found floating in immense quantities on the surface of the ocean. Some large tracts in the centre of

the North Atlantic are covered with the Sargasso weed (*Sargassum bacciferum*), brought by the gulf stream to a place where the water is nearly stagnant. Columbus compared them to inundated meadows. One of these tracts is stated to have an area as large as France. Similar masses of Macrocystis pyrifera are floating in the Southern Atlantic and the Pacific, and these are so dense that they have prevented ships being driven ashore in a heavy swell. These seaweed beds teem with animal life.

ON CALCULATING THE USEFUL EFFECT OF STEAM-ENGINES.

II.

It is my intention to show, in the next place, in what manner De Pambour's theory is applicable to the calculation of marine engines, and the effect they produce in the propulsion of vessels. For this purpose I beg to refer to pages 476 and 477 of Tredgold, where it is stated that the engines of the "Ruby" were of the following dimensions, viz.:—

Diameter of the cylinders = 40 inches;
Length of stroke . . = 3 feet 6 inches;

and that, when the engines made 30 strokes per minute, the "Ruby" acquired, with a draught of 4 ft. 8 in. abaft, and 4 ft. 1 in. forward, a velocity of 13.5 miles per hour. It is true, that for the calculation of the effect produced by the engines the principal datum is wanted—I mean the evaporation. But this we may ascertain, without fear of committing any very great error, by the following considerations. In the first place, it is stated at page 365, as a remarkable fact, that the boat did not vary her speed at any time more than 1-12th of a mile per hour; we may therefore, as she was a passenger boat, and would not, consequently, be subject to a great variation in her draught, conclude that her engines were working at the velocity corresponding to the maximum of useful effect, with a pressure of steam of 3½ lbs. above the atmosphere in the boiler. The next inquiry is, whether the boilers were fed with sea water or with fresh water; but it is apparent, from the foregoing conclusions, that the water must have been fresh, or nearly so, as otherwise the relative volume would have been less, and the speed of the engines could not have been what it really was, viz., 30 strokes, or 210 feet per minute.

Assuming these data to be correct, we find, as

$$S=\frac{l+c}{l}\,a\,v\,(n+q\,P)=\frac{l+c}{l}\,a\,v\,[(1+\delta)\,r+p+f];\ \text{making}$$

$p=445$;
$f=72$; and having
$P=2622.24$,
$v=210$,
$S=1.3784$;

whence we easily deduce r, or the load of one engine, per unit of surface of the piston. Knowing further, that the radius of the rolling circle, or of that circle whose circumferential velocity is equal to the velocity of the vessel, is

$$\varrho=\frac{5280\,\mathrm{v}^1}{2\times 60\times N\varpi}=6.302\ \text{feet};$$

v^1 representing the velocity of the vessel in miles per hour, and N the number of revolutions of the paddle-wheel shaft, we have, for the total resistance opposed to the motion of the vessel, at the velocity v,

$$(11.)\quad \begin{aligned} R&=\frac{2\,a\,l}{\varrho\varpi}\,r\\ &=\frac{2\,a\,l}{\varrho\varpi}\Big[\frac{l}{l+c}\cdot\frac{S}{a\,v\,(1+\delta)\,q}-\frac{1}{1+\delta}\,\Big(\frac{n}{q}+p+f\Big)\Big]\end{aligned}$$

whence the total effect of both engines,

$$60\,\mathrm{v}\,R=2\,a\,r\,v,$$

where v represents the velocity of the vessel in feet per second. On the other hand, the resistances opposed to the progress of the vessel through the water may also be expressed by the term—

$$(12.)\quad \mathrm{v}^2\,[\Phi F+\varphi O]=r',$$

where F stands for the midship section, and O for the total surface of the ship exposed to the adhesion of the water, both expressed in square feet; and where Φ and φ represent respectively the coefficients of head pressure, stern pressure, plus pressure, minus pressure, &c., and of adhesion. It will be seen that formula 12 indicates, to some extent, the shape of the vessel, and that it would suffice to express the total resistance opposed to its motion, if used as a sailing vessel for instance. In the case of a steamer, however, which is propelled by paddle-wheels, it is necessary to add to the above the resistances which arise from the working of the paddle-wheels. These are owing, 1st, to the oblique action of the floats; 2d, to the passage of the floats (being thin bodies) through the water; and 3d, to the adhesion of the floats to the water, and they may be expressed by

$$(13.)\quad (\Phi'+2\,\varphi+\chi)\frac{A\,m\,N}{30}\,\varrho\,y=r'',$$

where Φ' represents the coefficient of resistance due to the passage of thin bodies through the water, χ the proportion of power lost by reason of the oblique action of the floats, A the average efficient area of each float, m the number of floats in each paddle-wheel, y the average immersed radius of the wheel, and where the other notations remain as before. The coefficients Φ and φ in the foregoing equation, as well as the coefficients Φ and φ in equation 12, must be considered as having already been multiplied by the factor $\frac{w}{2\,g}$, where w denotes the weight of one cubic foot of water (either sea or fresh), and where $2\,g$ has the usual meaning.

The total resistance opposed to the motion of the steam-ship propelled by paddle-wheels, may thus be expressed by

$$(14.)\quad R=\varrho\,y\,\frac{A\,m\,N}{30}\,(1+\Phi'+2\,\varphi),\ \text{or}$$

$$(15.)\quad =\mathrm{v}^2\Big[(\Phi F+\varphi O)+(\Phi'+2\,\varphi+\chi)\frac{A\,m\,y}{\varpi\,\mathrm{v}}\Big]=\frac{2\,a\,l}{\varrho\varpi}\,r.$$

The value of A could be found by calculation, but it may also be easily ascertained by a diagram, as well as that of the average immersed radius, y; and having drawn the latter in its proper position, the sine and cosine of the angle which is enclosed between it and the perpendicular, will indicate the proportion of the effective power to that which is lost by the oblique action of the paddles.

From the above equations we also derive

$$(16.)\quad \varrho=\sqrt{\frac{60\,a\,l\,r}{A\,m\,N\varpi\,y\,(1+\Phi'+2\,\varphi)}}$$

$$(17.)\quad \mathrm{v}=\frac{N\varpi}{30}\sqrt{\frac{60\,a\,l\,r}{A\,m\,N\varpi\,y\,(1+\Phi'+2\,\varphi)}}$$

$$(18.)\quad \mathrm{v}^1=\frac{120\,N\varpi}{5280}\sqrt{\frac{60\,a\,l\,r}{A\,m\,N\varpi\,y\,(1+\Phi'+2\,\varphi)}}$$

$$(19.)\quad N=\frac{15\,(1+\delta)}{a\,l\,\big(\frac{n}{q}+p+f\big)}\Big[\frac{l}{l+c}\;\frac{S}{30\,(1+\delta)\,q}-\frac{A\,m\,y\,\mathrm{v}^2}{\varpi}(1+\Phi'+2\varphi)\Big]$$

$$(20.)\quad S=2\,(l+c)\,9\Big[a\,N\Big(\frac{n}{q}+p+f\Big)+15\,\frac{A\,m\,y}{\varpi}\,\frac{\mathrm{v}^2}{l}(1+\delta)(1+\Phi'+2\varphi)\Big]$$

$$(21.)\quad \Phi F+\varphi O=\frac{A\,m\,y}{\varpi\,\mathrm{v}}\,1-$$

With regard to the "Ruby," we find that, under the given circumstances, the total resistance opposed to her motion, at the velocity of 13.5 miles per hour, is 5288 lbs., and that her engines produce a joint effect of 190.38 horse power; the diagram also shows that the loss owing to the oblique action of the floats amounts to 0.2366 of the whole. If we suppose that the coefficients Φ' and φ vary in the ratio of $0.310\,\frac{\mathrm{v}\,i}{\mathrm{v}\,v}$, where i represents the depth of immersion in feet, we shall find the value of the term $\Phi'+2\,\varphi$ to be $=0.078$, and we should thence conclude that the sailing qualities of the "Ruby" are expressed by

$$\Phi F+\varphi O=9.552,\ \text{approximatively};\ \chi=0.2366.$$

Unfortunately we are short of one important item touching the construction of the paddle-wheels, and besides there seems to be an error in the given dimensions of the floats. The number of the floats is nowhere indicated; and the length of the boards is said to be 9 feet 2 inches, which would scarcely leave an inch of room between them and the sides of the paddle-box—(see plate 99.) But probably there are 12 floats in each wheel, and the length of them is 8 feet 7¼ inches about. These serious omissions prevent us from going into further investigations relative to this steamer, with a sufficient degree of confidence (such, for instance, as to find her velocity with a greater or less immersion than 1 foot 3 inches), unless we were to content ourselves with assuming the whole resistance to be embodied in the term $\Phi F+\varphi O$, in which case we should, of course, be led into errors of more or less magnitude. As to the values of F and O, they may be ascertained with sufficient accuracy from the plates; in this case I have computed them to be $F=63.2$, and $O=1350$.

Before I proceed further, I would beg leave to make a few remarks upon a statement contained on page 365 of "Tredgold;" for although opinions upon the working of steam-engines must have undergone a great change within the last six or seven years, yet it may not be quite superfluous to refer to certain points upon which differences of opinion have existed, when the explanation of them lies so near at hand. It is stated, as a curious fact, that the "Ruby" attained the great speed named, with such a small pressure, while in a variety of instances vessels from different outports, working with high-pressure steam, and with safety-valves loaded *ad libitum*, by the engineers and captains, have never been able to approach her in speed. And these observations are followed by another, to the effect, that the results before-mentioned show clearly what the late Mr. Watt demonstrated long ago, that the most efficient, safe, and economical mode of working steam-engines for marine purposes, is at a pressure of $2\frac{1}{2}$ to $3\frac{1}{2}$ lbs. to the inch. Setting aside the relative merits of the vessels and their engines, with which the "Ruby" was competing, it is evident that, if the engineers and captains had loaded the safety-valves to the extent of 50 lbs. upon the square inch, unless they had at the same time reduced the speed of the engines, or increased the evaporation, such a measure could not possibly have been of any service to them. For although the steam might be at a pressure of 50 lbs. to the square inch in the boiler, it does not follow that therefore the pressure in the cylinder would be greater than if the steam had been produced at a pressure of only 18 lbs. in the boiler, inasmuch as such increase of pressure in the cylinder could only take place in the case of the load being increased to a corresponding extent. On the other hand, it would have been within the reach of possibility (provided that the vacuum were kept up to the point) to have propelled the "Ruby" at the rate of 14.42 miles per hour, by employing steam ot the total pressure of 22.837 lbs. to the square inch, and reducing the speed of her engines to 24.346 revolutions per minute.

It would not be easy to give a good reason why, generally speaking, high-pressure steam should not be applicable to marine engines with the same advantage as to other kinds of steam-engines; yet there is one rather serious objection to high-pressure steam where paddle-wheels are used, and that is, the speed of the engines. High-pressure steam cannot be applied to advantage without the use of a variable expansion apparatus, and the earlier the steam is cut off (see formula 1), the greater must become the velocity of the piston, and therefore, in cases of direct connection with the paddle-wheel shaft, the velocity of this shaft. But formulæ 2 and 16 show, that the more this velocity increases *cæteris paribus*, the more the effect of the engine is reduced, and the less the speed of the vessel becomes. This is the reason why the American fast-going river boats are fitted with engines of from 14 to 16 feet stroke; for whatever may be the defects of such engines—and they cannot be trifling—they certainly admit of the steam being cut off to the required extent, and of the velocity of the paddle-wheel shaft being reduced as much as possible.

I shall take the liberty of referring to this point again further on; and I purpose next to apply the equations given above, to the case of the steamer "Medea," particulars of which are recorded at page 477 of the before-mentioned edition of "Tredgold," and at pages 84 and 85 of the Appendix. We find, in the first place, the following data relative to the engines of the "Medea:"

Diameter of cylinder, - - - -	4 feet 6 inches.
Length of stroke, - - - - -	5 feet.

With regard to the quantity of fuel used, it is stated that the engines consume about 8 lbs. of coal per horse power per hour, and that the total consumption per day, working at full power, is 18 tons 17 cwt. From these data I conclude that, reckoning 7 lbs. of coal for the evaporation of one cubic foot of water, each engine requires about 2.104 cubic feet of water per minute; consequently we have $S = 2.104$.

The information given relative to the speed of the engines is rather vague, and it becomes necessary to look out for a specific case; which we accordingly find at page 43 of the Appendix, where it is stated, that on one occasion the "Medea," with an immersion or dip of the paddle-board of 3 feet 11 inches, was propelled at the rate of 11.33 miles per hour, whilst the engines made 22.5 revolutions per minute. We should be in a similar predicament with regard to the dimensions of the paddle-wheel and floats of the "Medea," as in the case of the "Ruby," if we had not plates 82 and 83 to refer to, in which the principal dimensions of the wheels are given—with this difference, however, that whereas in the case of the "Ruby," such information was wanting altogether, we have, with reference to the "Medea," rather to complain of its variety.

Our data are—

$S = 2.104$, the evaporation in cubic feet per minute;
$a = 15.90435$, the area of the piston in square feet;
$N = 22.5$, the number of revolutions of the paddle-wheel shaft;
$l = 5.0$, the length of the stroke;

and I shall assume

$p = 3 \times 144 = 432$ lbs., the pressure opposed to the motion of the piston, owing to the defective vacuum in the cylinder;
$f = 0.5 \times 144 = 72$ lbs., the friction of the engine unloaded;

and as it appears very probable, that during the experiment the steam was generated from fresh water, n and q will remain as before. We obtain, therefore,

$r = 1317.1275$, the load of the engine per unit of surface of the piston, and since

$$R = \frac{2\,a\,l}{\rho\,\pi}\,r;$$

$R = 9854.868$, the total resistance opposed to the motion of the vessel at the given velocity. But we also know that

$$R = \rho\,y\,\frac{A\,m\,N}{30}\,(1 + \Phi + 2\,\varphi);$$

and because $\rho = 7.0524$ $(V = 16.617)$, the radius of the rolling circle;
$m = 11$, the number of floats in each wheel;
and, according to the diagram—
$A = 11.9125$, the average immersed area of each float;
$y = 10.875$, the average immersed radius of the wheel; we find
$\Phi' + 2\,\varphi = 0.2544$.

Also, according to formula (21),

$$\Phi\,F + \varphi\,O = \frac{A\,m\,y}{\pi\,V}\,(1 - \chi);$$

and as, in Morgan's wheels, no loss takes place through the oblique action of the paddles, and therefore $\chi = O$, we find

$$\Phi\ F + \varphi\,O = 27.2968.$$

From plate 100, it will be found that we may, approximatively, put $F = 268.4$, and $O = 7218$; the value of the coefficient φ could no doubt be ascertained from Beaufoy's experiments; but the only information I have at present within my reach upon this subject is, that for a mean immersion and velocity $\varphi = 0.0043$, so that it may not be very far from the truth, if, for the velocity and immersion now under consideration, we assume $\varphi = 0.00253$; in which case we should have

$$\Phi = 0.03366,\ \Phi' = 0.24934.$$

And it appears very probable that, whilst the coefficient Φ would be affected by the shape of the midship section of the vessel, and the coefficient Φ' by the shape and number of the floats, the term φ would remain the same for the same velocity and immersion.

The joint effect of the two engines of the "Medea," working at the velocity of 22.5 strokes per minute, would be 285.655 horse power.

It is further stated, at page 85 of the Appendix, that the rate of steaming of the "Medea," with 320 tons of coals and war equipment on board, was, in a calm, $8\frac{3}{4}$ knots, or about 10.062 miles per hour. The object is here to ascertain at what speed the engines must have been working, in order to produce that velocity. For this purpose, formula 19 may be employed, according to which—

$$N = \frac{15\,(1 + \delta)}{a\,l\,(\frac{n}{q} + p + f)}\left[\frac{l}{l + c}\cdot\ \frac{S}{30\,(1 + \delta)\,9}\ \ \frac{A\,m\,y\,v^2}{\pi}\,(1 + \Phi' + 2\,\varphi)\right]$$

But as we find, from page 3 of the Appendix, that during regular service in the Mediterranean, the engines of the "Medea" were supplied with steam generated from sea water, with the boiling point at 215°, whence its relative volume is reduced, we shall have to put

$$n = 0.0000458, \text{ and}$$
$$q = 0.000000279.$$

Our further data are then

$$V = 14.757;$$

and, according to the diagram,

$$y = 10.666,$$
$$A = 13.5.$$

The immersion being, according to page 84 of the Appendix, 5 feet 8 inches, I assume, according to the formula, $0.524\,\frac{\sqrt{i}}{\sqrt{v}}$, based upon the result of the foregoing case,

$$\Phi' + 2\,\varphi = 0.3246;$$

and thence find

$$N = 20.7569,$$
$$\rho = 7.2357;$$

under these circumstances, the joint effect of the two engines would be 264.434 horse power.

It is next mentioned, at page 85 of the Appendix, that when lightened by the expenditure of one-third of the fuel, the rate of steaming of the "Medea" was, in a calm, $9\frac{1}{4}$ knots, or about 10.6375 miles per hour. According to my calculation, the draught of the "Medea," when lightened to the extent mentioned, would be diminished about 1 foot; consequently, the immersion of the paddle-wheels would become 4 feet 8 inches. Our data would thus be

$$v = 15.6016$$
$$\Phi' + 2\varphi = 0.28657;$$

and, according to the diagram

$$A = 12.9296$$
$$y = 10.75;$$

when we should obtain

$$N = 18.5135$$
$$\epsilon = 8.0473;$$

and for the joint effect of the two engines, 277.105 horse power.

We should also find that, with a velocity of the paddle-wheel shaft of 15 revolutions per minute, and at the immersion of 5 feet 8 inches, the "Medea" would, according to formula 18, be propelled at the rate of 10.696 miles per hour, when we should have

$$\Phi' + 2\varphi = 0.3163$$
$$\epsilon = 9.987;$$

and the joint effect of the two engines = 296.949 horse power.

THE TELEGRAPH—ITS HISTORY AND PRESENT CONDITION.

The art of conveying intelligence by means of signals has been known for ages, even amongst the rudest savages with whom civilized nations have formed any acquaintance; but it is a remarkable fact, that the long possession of the idea has scarcely led to any improvement upon the original conception until our own times. In 1684, Dr. Hooke struck out the first novelty, by proposing the use of a number of different figures, as squares, triangles, and circles, arranged to correspond with the letters of the alphabet. Subsequently, M. Amontons demonstrated the practicability of such a system, before the royal family of France, and the Academy of Science; but the first telegraph which really deserved the name was that of M. Chappe, introduced in 1794, when it was put in operation for the conveyance of intelligence to the French army, and received the name of "semaphore."

The arrangement consisted of a beam, fitted to oscillate on a centre, carried by a perpendicular pillar. At the top and bottom of the beam were placed two moveable arms, and the compound movements of the beam and arms formed various signals representing the alphabetical characters.

In 1795, Lord George Murray submitted a plan to the Admiralty, and it was kept in operation by the Board until the year 1816. He employed six shutters, placed in two frames, and the opening and closing of these produced sixty-three different signals.

In 1807, General Pasley introduced a plan differing considerably from the French semaphores, and termed by the inventor the "polygrammatic telegraph." Its novelty consisted in having a series of beams oscillating on the same pivot; and to obtain a sufficient number of signals, it was proposed to erect two or three posts at each station.

Sir Home Popham, in 1816, simplified this plan very considerably, merely by placing two arms, moveable on separate centres, on the same post; and this modification was adopted by the Admiralty in preference to the "shutter" telegraph.

Lastly, General Pasley, in 1822, added an improvement, by placing the two arms on the same centre, and thus brought this mechanical or optical contrivance to the greatest perfection it ever possessed. Until very recently, this rude system of signalling was in regular operation between the Admiralty and Portsmouth; the proportion of days in the year when it could be employed, being probably not more than one-fifth of the actual time, owing to fogs and dark days.

From a passage in "Young's Travels in France," published in 1787, it would appear that a mode of transmitting telegraphic signals by the aid of common electricity, was known and practised, to a certain extent, even at that early period; but, with the fact before us, we are left entirely in the dark as to the details of the arrangement. We are only told that M. Lomond was the user or promoter of the system. The earliest practical development of the now vastly important electric telegraph, as far as we can make out, is due to a valuable correspondent of our own, Mr. R. Smith, of Blackford, Perthshire, who, in later years, has earned for himself considerable reputation as a chemist. In 1828, Mr. Smith, then a mere boy, residing in Glasgow, exhibited in action two working models of electric telegraphs, in the academy of a Mr. Robb, in Gordon Street. This exposition of the invention was witnessed by a considerable assemblage of persons interested in the then novel discovery; and many of the young philosopher's visitors are yet alive to bear testimony to the merit due to him. One of these models consists of a square board, covered on one side with tinfoil, upon which the two letters, A and B, are painted. The board is placed upright on a stand, and a second standard, having two short glass tubes fixed upon it, is placed in front of the board. A corresponding standard is stationed at the opposite end of the room, a couple of wires being stretched between the two stands, the ends being passed through the tubes in each standard. The end of each wire is placed opposite the letters, and distant from them about $\frac{1}{4}$ of an inch, one wire being at A, and the other at B. When the telegraph is put in operation, a charged Leyden jar is brought into contact with the opposite end of one of the wires, and the current passes along the wire to the tinfoil, a bright spark appearing at the letter. Consequently, by keeping a few jars constantly charged, a continuous supply of signals may be kept up. For instance, a single spark at each of the letters produces two distinct signals, two sparks at each gives other two. A spark at one, and two at the other, gives two more, and so on. In this way twenty-six signals were easily produced. In 1829, an instrument of this nature was exhibited before the Emperor of Russia, by Dr. Charles. The second model consists of a box with a card placed in its bottom, and having a number of letters arranged round its margin, whilst in the centre is fixed a pivot, carrying a magnetic needle, as in a mariner's compass. Two wires, bent at the middle, are placed in the box, at right angles to each other, one bend being below, and the other above the needle. The four ends of the two wires pass along to the mercury-cup communicator in connection with the battery, and with the keys for bringing the ends of the wires into contact with the mercury. When the current is made to pass along one of the wires, the needle is deflected from its normal position, and, taking up a new one, points to a given letter upon the card. If the current is similarly passed along the other wire, a separate indication is produced. Also, when the currents are reversed, a further series is obtained, the whole being made available for the representation of certain known characters. This ingenious little contrivance is still in existence, to exemplify the principle of the present needle telegraph. Travelling down the current of time, we find that, in 1830, Sir Humphrey Davy and Dr. Ritchie were associated in a series of experiments in electro-telegraphic matters; but their attempts have left no successful result behind them.

In 1837, Mr. Alexander displayed an ingenious telegraphic apparatus before the Royal Scottish Society of Arts. He arranged, in a square box, a set of wires corresponding to the alphabetical characters, and at one end were placed a row of keys, like those of a piano, a galvanic battery being beneath them, whilst at the opposite end were a set of magnetic needles, any one of which being affected by the electric current arising from touching the corresponding key, was turned to the right or left, unveiling by its movement the particular letter which it guarded. When the finger was removed from the key, the magnet affected turned back to its normal position, so as to cover its letter.

To Professor Wheatstone we are indebted for a most important improvement on these crude schemes. In 1840, he exhibited in his class-room the most improved instrument of his day. He used two small galvanic batteries, with four copper wires four miles in length. A small brass apparatus, resembling a clock, containing a dial or minute opening sufficient to show a single letter, and at the opposite ends of the wires was a pivot with a circular top, having upon it the letters of the alphabet, an index being set to radiate from each letter like the levers of a capstan. To put the telegraph in action, the capstan is turned until the metal point of a given letter upon it is made to touch a corresponding point near the side of the case. A touch of the point opposite A, will bring A into view on the dial, and so on with any other letter. By this plan, the letters can be exposed with very considerable quickness.

Amongst other improvers, Mr. Cook has done much for the electro-magnetic telegraph.

Again, in 1841, Mr. Smith, in pursuing his long train of experiments, came upon his plan of electro-chemical instruments, which he made public in March, 1842. By this apparatus, printed characters are produced on slips of paper moistened with a solution of ferro-cyanide of potass and nitric acid. The electricity transmitted by wires to the receiving apparatus, decomposes the liquid upon the paper, and in combining with a portion of the iron of which the types are formed, deposits cyanide of iron on the paper, producing dark blue characters on a white ground. We are, perhaps, not saying too much, when we claim for Mr. Smith the honour of being in reality the original practical inventor of the electric telegraph, in as far as he first conceived the notion of applying all the various effects which, up to the present day, have been tried for transmitting intelligence on the electric principle, namely, frictional-electricity, electro-magnetism, and electro-chemistry.

In 1843, Mr. Alexander Bain patented another form of electro-chemical telegraph. The communication, written on tinfoil with wax varnish, is applied to the transmitting instrument, which consists of a cylinder having a point resting on its surface, and in contact with a battery. The receiver is similar to the transmitter, and on it is placed a slip of paper wet with a solution of ferro-cyanide of potass and a little acid. When the current passes through both instruments, a decomposition of the solution occurs upon the receiving instrument, where the paper covering is touched by the steel wire. Thus, blue lines are formed on the paper; but, as the motion of the instruments proceeds, the electric current is interrupted where the varnish writing occurs, and a blank is left. In this way the characters are white, or negative, whilst the rest of the paper is covered with lines. Like a model of a machine, on a small scale, this apparatus works well as a mere philosophical experiment; but it has hitherto proved impossible to work the two cylinders at opposite termini, so as to move in exactly equal time through the same space, even under the superintending regulation of an electro-magnet.

In 1847, Professor Morse, an American philosopher, introduced a telegraph worked by the magneto-electric machine. His instrument consists of an electro-magnet, with a lever placed above it; whilst on the lower side is fixed, opposite the poles of the magnet, an iron bar or keeper, and a spring retains the bar at a short distance from the magnet. At the outer end of the lever, on the lower side, is a steel point, and below this is a grooved roller. A slip of paper is traversed over the roller by clockwork, and when the current is transmitted along the wires, the electro-magnet becoming excited, attracts the iron bar, which brings down the lever, and the point makes a mark or hole in the paper. If the current is interrupted, the magnetic power ceases, and the spring again raises the lever; so that, by opening and closing the circuit, marks are formed on the paper, answering as the signal hieroglyphics.

To Mr. Bain belongs the credit of another most ingenious electro-magnetic telegraph of the needle kind, erected by him in 1845, and at present at work on the Edinburgh and Glasgow Railway. This has been often described. In February, 1846, another electro-chemical telegraph was exhibited by Mr. Smith before the Royal Scottish Society of Arts. This is a modification and improvement of his earlier plan for a like purpose, before noticed. A riband of cotton or paper is made to pass through a trough filled with a solution of ferro-cyanide of potassium, with a few drops of nitric acid. This riband, so treated, is drawn by clockwork over a leaden cylinder in communication with the negative end of the battery; whilst there is in contact with the positive wire an impress wire, resting immediately over the riband, as it passes over the leaden cylinder. When the circuit is completed, by pressing down a key with the finger, the current passes along to the impress wire, and a blue mark is printed on the paper; the electricity decomposing the ferro-cyanide of potassium, and forming ferro-cyanide of iron. When the circuit is closed and broken with rapidity, a succession of marks or dots is printed upon the riband; but if closed for a longer time, and then broken, the marks are made of greater length. Hence long and short spaces, dots, and short lines, are formed at pleasure, and from them is made a telegraphic alphabet. In session 1846, a prize was awarded to Mr. Smith, by the Royal Scottish Society of Arts, for this invention; and it was patented in the United States by Messrs. Smith and Bain, in connection with some improvements of the latter gentleman in electro-chemical telegraphs. Later, in the year 1849, Mr. Bakewell patented his electro-chemical instrument, as described at page 123, vol. ii. of this Journal. The inventor has named this a copying electric telegraph. Its similarity to Mr. Bain's prior invention has led to much controversy.

Lastly, Mr. Birt produced a printing telegraph of somewhat complicated construction. It is a combination of electro-magnetic apparatus and printing machinery, and possesses many features of ingenuity. Mr. Smith, to whose labours we have often made reference, has just completed a design for a new plan of telegraph, which he considers to be very superior to any existing arrangement. By it he can produce a copy of handwriting, with the letters black, on a white ground, or a reprint of a newspaper, the types being at one terminus, whilst the reprint is produced at the other.

HIGGINBOTHAM AND GRAY'S FEED APPARATUS FOR STEAM-BOILERS.

(*Illustrated by Plate 69.*)

It is an acknowledged fact, that by far the greater number of steam-boiler explosions arise from irregularities in the water-supply; and we consider, that in throwing out even the most simple hint which may tend to a more extended examination into the arrangement of the existing boiler-feeding apparatus, we shall do what is, emphatically, our duty. It is presumed, however, that by introducing Mr. Gray's invention to the readers of this Journal, we shall do something more than draw attention to obvious defects, for we shall submit a plan worthy of the test of the practical man, with a view to their removal.

The ordinary modes of water-supply now in use, are, in general terms, divisible into two classes—the overhead-pipe, or hydrostatic pressure-feeder, and the common force-pump. Where high-pressure steam is used, the necessary height of the water column feed-pipes is felt as an important objection to the first-mentioned plan; and in the second, much power is obviously expended in forcing in water against the boiler pressure, whilst a difficulty is experienced in keeping the boiler water-level at the desired height. The invention before us, recently patented by Mr. Matthew Gray, of Morris Place, Glasgow, is proposed for the removal of both difficulties, the water-level being constantly adjusted by intermittent condensations of steam in the supply chamber.

In plate 69, we present two views of the apparatus. Fig. 1 is a vertical sectional elevation of the feeder as fitted to the top of a boiler; fig. 2 is a plan of the apparatus. A short cylinder, A, which we have termed the condensing receiver, is bolted down to the bottom of the feed water-chest, B, open at the top, and resting upon the flange, C, of the two vertical pipes, D E. These two pipes are cast in one piece, and descend into the boiler, F, to the top of which they are bolted by a flange at G. The open lower end of the pipe, D, is set so as to be just beneath the proper working level of the water in the boiler, as at H; and its upper end opens into the pipe, I, cast on the side of the cylinder, A, the same bolts serving to connect both the pipes, D and E, and the cylinder, A, to the bottom of the chest, B. The two pipes, D I, thus form a single continuous thoroughfare from the boiler to near the top of the cylinder, A, and the upper end of which thoroughfare is guarded by a conical-seated valve, J, opening downwards. The other pipe, E, descends to near the bottom of the boiler, its lower end being also open, whilst its upper end is likewise guarded by a large valve, K, opening downwards. These valves are fitted with connecting-rods, L M, passing upwards through stuffing-boxes in the cover of the cylinder, A, and furnished with slotted eyes, N O, by which they are connected with the actuating lever, P. This lever oscillates on a fixed centre, Q, carried by a bracket bolted to the top of the chest, B, its shorter end having upon it an adjustable counter-weight, R. The opposite longer end of the lever is formed into a rectangular frame, S, for the purpose of receiving the balanced sheet-iron bucket, T, oscillating on pivots, U, in the frame. The water-supply is derived from the pipe, V, having upon it a stop-cock, W, worked by the lever of the ball-float, X, attached to the key of the stop-cock; this stop-cock being set so as to give a slight discharge of water even when the ball-float, X, is at the top of its rise. In other words, however high the water-level in the chest may rise, the supply from the pipe, V, is never wholly cut off. The end of the pipe, V, is bent so as to bring its discharge aperture over the bucket, T. In explanation of the action of this contrivance, we will suppose the boiler water-level to have fallen a little beneath the lower end of the pipe, D, and consequently the pipe, D I, is filled with steam. Then the gradual discharge of water into the bucket, T, at length overbalances the dead weight, R, and the long end of the lever in descending carries with it the rods, L M, and opens the valves, J K, thus admitting steam from the boiler to the condensing receiver, A. At the same time, the projection, Y, on the end of the bucket, T, comes in contact with the fixed stop, Z, on the side of the chest, B, thus upsetting the bucket, the contents of which are poured into the chest beneath. The removal of the water's weight then allows the weight, R, to elevate the bucket, and close the two valves. This action has filled the condenser, A, with steam, which is immediately condensed by the water in the chest surrounding it. The partial vacuum thus produced causes the small spring-loaded valve, *a*, to open inwards, admitting water from the chest into the condenser. The succeeding depression of the bucket-lever again opens the two valves, J K, and steam passes as before up the pipe, D I, and presses on the surface of the water in the condenser, forcing it down the pipe, E, into the boiler. This action will be periodically renewed, until the water-level in the boiler rises above the end of the pipe, D, cutting off the admission of steam into this pipe, and putting an end to the intermittent condensation in the receiver, A. The boiler will then receive no more water, notwithstanding the valves J and K continue to be periodically opened, until steam is again permitted to ascend the pipe, D I, when water will be supplied as before.

The peculiarity of the working of this feeder is, that whilst an intermittent action of the inlet valve for the water-supply is continuously kept up, the interval of time between each movement is quicker or slower in exact accordance with the wants of the boiler. Thus, if the water should happen to get low in the boiler, the periodical condensations of the steam in the receiver will take place in rapid succession; and as the water in the chest will thus be carried off at a quick rate, the fall of

Plate 69.

FEED APPA[RATUS]
FOR STEAM BO[ILERS]

Scale, 1½ Inch = 1 F[oot]

Fig. 1.

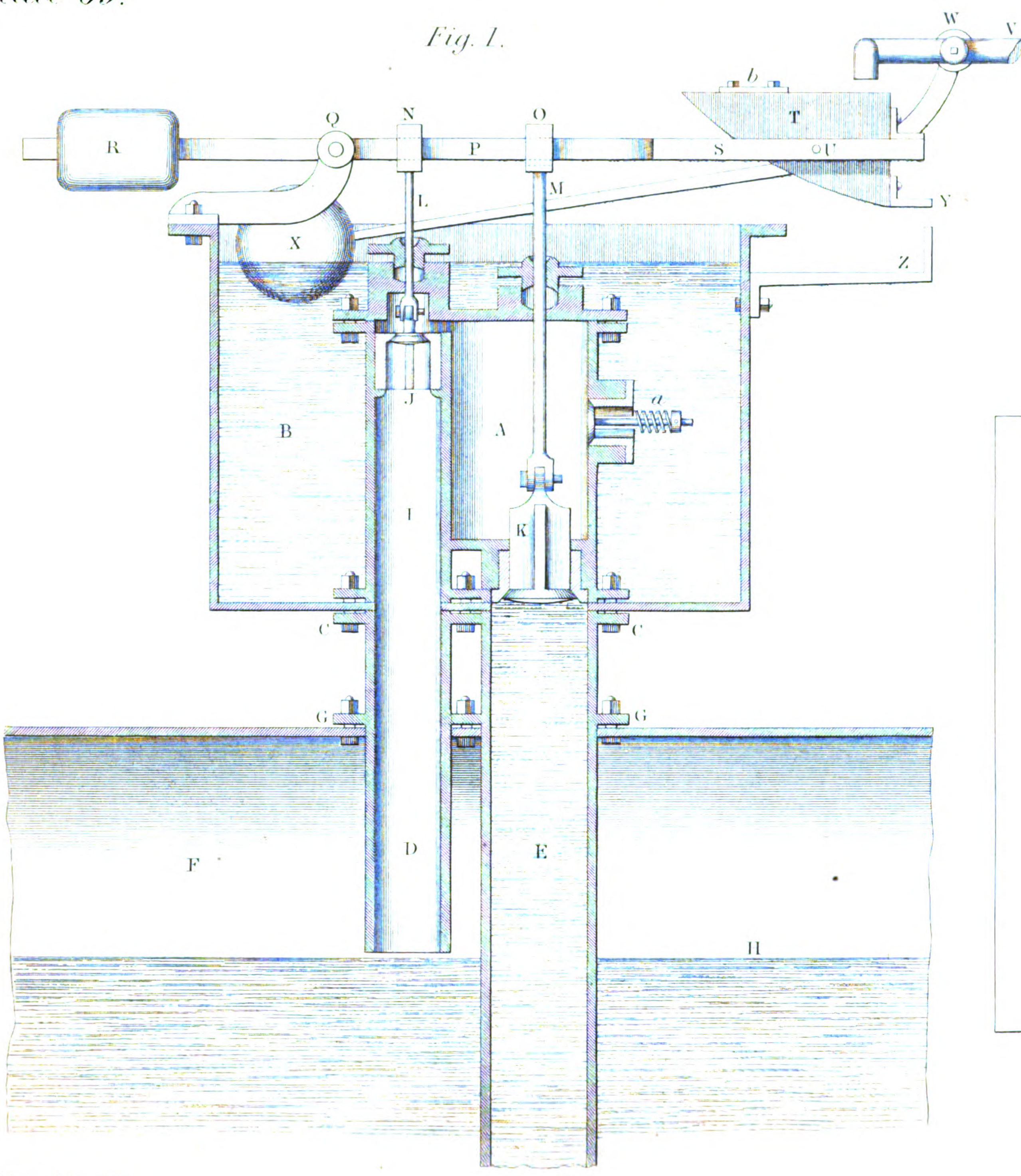
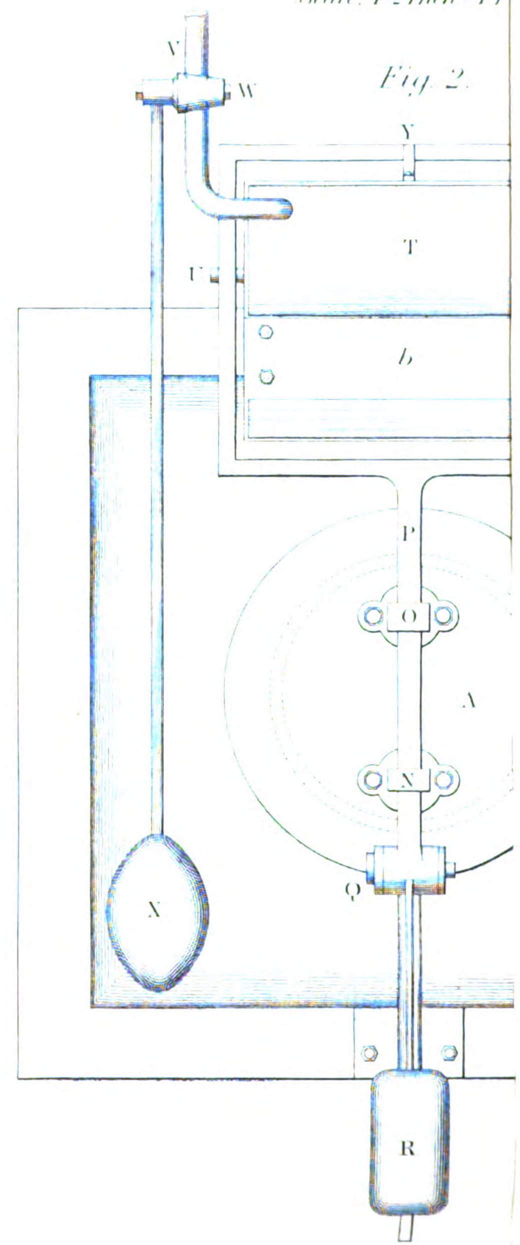


Fig. 2.



E. J. Hixson, Patent Office.

the float, X, will obviously open the supply stop-cock to a greater extent. In this way the bucket, T, will be more rapidly filled, giving a corresponding quicker action to the steam and water valves. To allow the valves to open easily, the slot in the head of the rod of the valve, K, is made rather longer than the width of the lever, so that, when the latter begins to move, it acts only on the smaller valve, J. This valve, being near the fulcrum of the lever, is easily opened by the loaded bucket, and when open, the steam admitted by it balances the pressure upon the larger valve, which thus opens of itself. To prevent the bucket rising again too suddenly after its discharge, an adjustable cover-plate, *b*, is fastened across its mouth. This retards the flow of water, and keeps down the lever long enough to allow time for the water in the receiver to be forced into the boiler.

In this clever contrivance, it will be seen that the water-supply is quite independent of the action of any internal boiler-floats or other apparatus, the opening and closing of an open pipe by the rising or falling of the water itself being the adjusting feed action. By attaching a separate apparatus to two sets of pipes communicating with a series of boilers, the same arrangement may be made to serve for any number of boilers. The modification which we have illustrated and described, has been at work for some time at the extensive manufacturing and printing works of Messrs. Todd and Higginbotham at Glasgow; Mr. Higginbotham being associated with the inventor in the prosecution of the improvement. Its successful application may be seen there by any parties interested in this branch of mechanical improvement.

The patentee has proposed two other modifications of his plan—one being actuated by a continually revolving crank acting on the valve lever; whilst, in the other, the lever is dispensed with, the movement being obtained entirely from floats on a vertical spindle contained in the condensing receiver.

ON THE PROPULSION OF STEAMERS.

Concluding Remarks by Mr. Ewbank.

IV.

From the specimens of nature's propellers quoted, (and they represent countless millions from every division of the animated kingdom for which air and water are the theatres,) we see that those creatures possessing the powers of locomotion in the greatest perfection are furnished, not with remarkably *large propellers*, but with long, narrow, and pointed ones—in no case bounded by straight lines. There is a meaning, a deep meaning, too, which engineers have not yet perceived, in this absence of rectangular and right-lined boundaries—this lengthening, forking, and pointing—this uniform effort at angularity.

If it be conceded that Nature is an exponent of the Divine Inventor's ideas, and consequently of the truest philosophy of mechanics—that as an economist of power and material she cannot be excelled; and in the forms, adaptations, and results of her machines, she is absolutely perfect—does it not become us to consult her on a subject which she has so profusely illustrated, and attend, as it were, to one course, if not more, of her lectures?

If she has nowhere adopted the figure of our steamers' buckets, (nor anything like them,) in the multiplicity of her submerged propellers, nor in her surface paddles, nor in the motive implements of amphibia, nor in the countless swarms of minute aqueous beings—if, so far from approaching, she has carefully avoided it in her swimming and diving myriads, from the leviathan of the ocean to the minnow of brooks and the animalculæ of our cisterns—what are we to think? That she is chargeable with awkwardness in her work, and ignorance in the selection of means proper to her end? and that the shape we have contrived for urging both large and small bodies through water is better than any of hers? Or shall we not rather confess, that in adhering to ancient practice* we MAY be wrong; and resolve, instead of blundering on longer in the dark, to consult her at once, by testing her forms and proportions against ours?

Then, what is still more eminently significant, she confines not her favourite principles to water, but displays them in as high relief in another fluid; as if to show us, by endlessly-diversified organisms sporting in different media, the demonstrations of her plans. In the wings of birds, bats, insects, and every aerial soarer, from the condor to the mosquito, as also in the feet of water fowl, from the largest to the smallest, the quickest to the slowest, she tenaciously holds on to *angular forms* and *pointed extremities*; thus elucidating and enforcing her views of the doctrines of propulsion, as relates to both air and water, by arguments enchanting and conclusive.

Admitting, to the fullest extent, that artificial organs can seldom follow literally the contours of natural ones, still is it not remarkable that, in the *infinity* of her modifications of propelling blades, she has rejected everything like a parallelogram or a square; and has, moreover, *never* united the broadside of one to the body that is to move, or to the levers that are to work it—on the contrary, making the connection invariably at an angle.

To the last remark it may be objected by the querulous, that the *sciurus volans* is an exception. Not so; this, though named one, is not a flying animal; the expansion of skin uniting the fore and hind legs is a buoyant, not a motive implement. It has no play, but merely serves to keep the little creature from descending as quickly, on taking a leap, as it otherwise would. Whatever slight progression it makes on passing from one tree to another, over and above what is due to the spring taken at starting, is ascribable to the sinuous or sculling motions of the tail; and this application of that member accords with what naturalists tell us of companies of voyaging squirrels of Lapland, crossing in calm weather rivers and even extensive lakes. Each individual launches and manages its own canoe—a piece of bark—using its tail as a propeller, and the air as a resisting medium.

There are those who smile at the idea of engineers and machinists studying Nature's contrivances; and such, on perusing the preceding suggestions, will deem it a sufficient reply to remind the proposer that steamers are not blackfish, nor paddles salmons' tails or petrels' feet. But minds differently organized think a glance into her workshops is never amiss, and that the longer the visit the better for the visitor, since there is no art or contrivance—and it is certain, that through eternity there never can be one—which has not its prototype in her collections. If we find them not, it is because of inattention, or an imperfect acquaintance with her stores. Perhaps we know not at which of her ateliers to inquire, or are not prepared to appreciate specimens laid before us when we enter.

As already intimated, no person expects to find in living mechanisms exact copies for artificial articulations; but when a mechanical principle, and the instruments through which that principle is manifested, are before us—when we see motion communicated to a class of organs, comprehend their construction, effect of their forms, modes of their action, and dynamic results—there is no difficulty in making such deviations, as difference in materials, powers to be employed, and conditions under which the artificial machine is required to act, may require. It is the perfection of invention thus to *imitate* Nature—the maturity of science and art to tread in her steps.

There is matter of the highest interest and deepest curiosity in this subject of natural propellers. To any single division, folios might be dedicated; every step taken in the investigation being attended with the revelation of new truths in mechanical science.

* Our steamers' wheels differ in nothing material from those used over twenty centuries ago in Roman galleys. In early printed books, the blades of paddle-wheels are figured as now. See the *Nuremberg Chronicle* of 1493; Rivius's German Translation of Vitruvius in 1548; and editions of Valturius and other old writers on military affairs.

THEORETICAL CONSIDERATIONS ON THE EFFECT OF PRESSURE IN LOWERING THE FREEZING POINT OF WATER.†

By James Thomson, Esq., C.E., Glasgow College.

Some time ago my brother, Professor William Thomson, pointed out to me a curious conclusion to which he had been led, by reasoning on principles similar to those developed by Carnot, with reference to the motive power of heat. It was, that *water at the freezing point may be converted into ice by a process solely mechanical, and yet without the final expenditure of any mechanical work.* This at first appeared to me to involve an impossibility, because water expands while freezing; and therefore it seemed to follow, that if a quantity of it were merely enclosed in a vessel with a moveable piston, and frozen, the motion of the piston, consequent on the expansion, being resisted by pressure, mechanical work would be given out without any corresponding expenditure; or, in other words, a perpetual source of mechanical work, commonly called a perpetual motion, would be possible. After further consideration, however, the former conclusion appeared to be incontrovertible; but then, to avoid the absurdity of supposing that mechanical work could be got out of nothing, it occurred to me that it is necessary farther to conclude, that *the freezing point becomes lower as the pressure to which the water is subjected is increased.*

The following is the reasoning by which these conclusions are proved.

First, to prove that water at the freezing point may be converted

† This paper was read some time ago before the Royal Society of Edinburgh; it has now been communicated to us by the author, with a few alterations, as possessing some interest in connection with our recent papers on heat.—Ed. *P. M. Journal.*

into ice by a process solely mechanical, and yet without the final expenditure of any mechanical work:—Let there be supposed to be a cylinder, and a piston fitting water-tight to it, and capable of moving without friction. Let these be supposed to be formed of a substance which is a perfect non-conductor of heat; also, let the bottom of the cylinder be closed by a plate, supposed to be a perfect conductor, and to possess no capacity for heat. Now, to convert a given mass of water into ice without the expenditure of mechanical work, let this imaginary vessel be partly filled with air at 0° C.*, and let the bottom of it be placed in contact with an indefinite mass of water, a lake for instance, at the same temperature. Now, let the piston be pushed towards the bottom of the cylinder by pressure from some external reservoir of mechanical work, which, for the sake of fixing our ideas, we may suppose to be the hand of an operator. During this process the air in the cylinder would tend to become heated on account of the compression, but it is constrained to remain at 0° by being in communication with the lake at that temperature. The change, then, which takes place is, that a certain amount of work is given from the hand to the air, and a certain amount of heat is given from the air to the water of the lake. In the next place, let the bottom of the cylinder be placed in contact with the mass of water at 0°, which is proposed to be converted into ice, and let the piston be allowed to move back to the position it had at the commencement of the first process. During this second process, the temperature of the air would tend to sink on account of the expansion, but it is constrained to remain constant at 0° by the air being in communication with the freezing water, which cannot change its temperature so long as any of it remains unfrozen. Hence, so far as the air and the hand are concerned, this process has been exactly the converse of the former one. Thus the air has expanded through the same distance through which it was formerly compressed; and since it has been constantly at the same temperature during both processes, the law of the variation of its pressure with its volume must have been the same in both. From this it follows, that the hand has received back exactly the same amount of mechanical work in the second process as it gave out in the first. By an analogous reason, it is easily shown that the air also has received again exactly the same amount of heat as it gave out during its compression; and, hence, it is now left in a condition the same as that in which it was at the commencement of the first process. *The only change which has been produced, then, is, that a certain quantity of heat has been abstracted from a small mass of water at* 0°, *and dispersed through an indefinite mass at the same temperature, the small mass having thus been converted into ice.* This conclusion, it may be remarked, might be deduced at once by the application, to the freezing of water, of the general principle developed by Carnot, that no work is given out when heat passes from one body to another without a fall of temperature; or rather by the application of the converse of this, which, of course, equally holds good, namely, that no work requires to be expended to make heat pass from one body to another at the same temperature.

Next, to prove that the freezing point of water is lowered by an increase of the pressure to which the water is subjected:—Let the imaginary cylinder and piston employed in the foregoing demonstration, be again supposed to contain some air at 0°. Let the bottom of the cylinder be placed in contact with the water of an indefinitely large lake at 0°; and let the air be subjected to compression by pressure applied by the hand to the piston. A certain amount of work is thus given from the hand to the air, and a certain amount of heat is given out from the air to the lake. Next, let the bottom of the cylinder be placed in communication with a small quantity of water at 0°, enclosed in a second imaginery cylinder similar in character to the first, and which we may call the water cylinder, the first being called the air cylinder; and let this water be, at the commencement, subject merely to the atmospheric pressure. Let, however, resistance be offered by the hand to any motion of the piston of the water cylinder which may take place. Things being in this state, let the piston of the air cylinder move back to its original position. During this process, heat becomes latent in the air on account of the increase of volume, and therefore the air abstracts heat from the water, because the air and water, being in communication with one another, must remain each at the same temperature as the other, whether that temperature changes or not. The first effect of the abstraction of heat from the water must be the conversion of a part of the water into ice, an effect which must be accompanied with an increase of volume of the mass enclosed in the water cylinder. Hence, on account of the resistance offered by the hand to the motion of the piston of this cylinder, the internal pressure is increased, and work is received by the hand from the piston. Towards the end of this process, let the resistance offered by the hand gradually decrease, till just at the end it becomes nothing, and the pressure within the water cylinder thus becomes again equal to that of the atmosphere. The temperature of the mass of partly frozen water must now be 0°, and the air in the other cylinder, being in communication with this, must have the same temperature. The air is therefore at its original temperature, and it has its original volume, or, in other words, it is in its original state. Further, let the ice be converted, under atmospheric pressure, into water; the requisite heat being transferred to it from the lake by the mechanical process already pointed out, which involves no loss of mechanical work. Thus, now at the conclusion of the operation, the whole mass of water is left in its original state; and likewise, as has already been shown, the air is left in its original state. Hence no work can have been developed by any change on the air and water which have been used. But work has been given out by the piston of the water cylinder to the hand; and therefore an equal quantity of work must have been given from the hand to the air piston, as there is no other way in which the work developed could have been introduced into the apparatus. Now, the only way in which this can have taken place is by the air having been colder while it was expanding in the second process, than it was while it was undergoing compression during the first. Hence it was colder than 0° during the course of the second process; or, in other words, *while the water was freezing under a pressure greater than that of the atmosphere, its temperature was lower than* 0°.

The fact of the lowering of the freezing point being thus demonstrated, it becomes desirable, in the next place, to find what is the freezing point of water for any given pressure. The most obvious way to determine this would be by direct experiment with freezing water. I have not, however, made any attempt to do so in this way. The variation to be appreciated is extremely small—so small, in fact, as to afford sufficient reason for its existence never having been observed by any experimenter. Even to detect its existence, much more to arrive at its exact amount by direct experiment, would require very delicate apparatus, which would not be easily planned out or procured. Another and a better mode of proceeding has, however, occurred to me: and by it we can deduce, from the known expansion of water in freezing, and the known quantity of heat which becomes latent in the melting of ice, together with data founded on the experiments of Regnault on steam at the freezing point, a formula which gives the freezing point in terms of the pressure; and which may be applied for any pressure, from nothing up to many atmospheres. The following is the investigation of this formula:—

Let us suppose that we have a cylinder of the imaginary construction described at the commencement of this paper; and let us use it as an ice-engine analogous to the imaginary steam-engine conceived by Carnot, and employed in his investigations. For this purpose, let the entire space enclosed within the cylinder by the piston, be filled at first with as much ice at 0° as would, if melted, form rather more than a cubic foot of water, and let the ice be subject merely to one atmosphere of pressure, no force being applied to the piston. Now, let the following four processes, forming one complete stroke of the ice-engine, be performed.

Process 1.—Place the bottom of the cylinder in contact with an indefinite lake of water at 0°, and push down the piston. The effect of the motion of the piston is to convert ice at 0° into water at 0°, and to abstract from the lake at 0° the heat which becomes latent during this change. Continue the compression till one cubic foot of water is melted from ice.

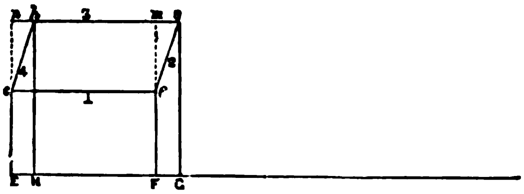
Process 2.—Remove the cylinder from the lake, and place it with its bottom on a stand which is a perfect non-conductor of heat. Push the piston a very little further down, till the pressure inside is increased by any desired quantity which may be denoted in pounds on the square foot, by p. During this motion of the piston, since the cylinder contains ice and water, the temperature of the mixture must vary with the pressure, being at any instant the freezing point which corresponds to the pressure at that instant. Let the temperature at the end of this process be denoted by $-t°$ C.

Process 3.—Place the bottom of the cylinder in contact with a second indefinitely large lake at $-t°$, and move the piston upwards. During this motion the pressure must remain constant at p above that of the atmosphere, the water in the cylinder increasing its volume by freezing, since, if it did not freeze, its pressure would diminish, and therefore its temperature would increase, which is impossible, since the whole mass of water and ice is constrained by the lake to remain at $-t°$. Continue the motion till so much heat has been given out to the second lake at $-t°$, as that, if the whole mass contained in the cylinder were allowed to return to its original volume without any introduction or abstraction of heat, it would assume its original temperature and pressure. This, if Carnot's principles be admitted, as they are supposed to be throughout the present investigation, is the same as to say,—Continue the motion till all the heat has been given out to the second lake at $-t°$, which was taken in during Process 2, from the first lake at 0°.

* The centigrade thermometric scale is adopted throughout this paper.

Process 4.—Remove the cylinder from the lake at $-t°$, and place its bottom again on the non-conducting stand. Move the piston back to the position it occupied at the commencement of Process 1. At the end of this fourth process, the mass contained in the cylinder must, according to the condition by which the termination of Process 3 was fixed, have its original temperature and pressure, and therefore it must be in every respect in its original physical state.

By representing graphically in a diagram the various volumes and corresponding pressures, at all the stages of the four processes which have just been described, we shall arrive, in a simple and easy manner, at the quantity of work which is developed in one complete stroke by the heat which is transferred during that stroke from the lake at 0° to the lake at $-t°$. For this purpose, let E be the position of the piston at



the beginning of Process 1; and let some distance, such as E G, represent its stroke in feet, its area being made a square foot, so that the numbers expressing, in feet, distances along E G, may also express, in cubic feet, the changes in the contents of the cylinder produced by the motion of the piston. Now, when 1·087 cubic feet of ice are melted, one cubic foot of water is formed. Hence, if E F be taken equal to ·087 feet, F will be the position of the piston when one cubic foot of water has been melted from ice, that is, the position at the end of Process 1, the bottom of the cylinder being at a point A, distant from F by rather more than a foot. Let F G be the compression during Process 2, and H E the expansion during Process 4. Let $e f$ be parallel to E F, and let E e represent one atmosphere of pressure; that is, let the units of length for the vertical ordinates be taken such that the number of them in E e may be equal to the number which expresses an atmosphere of pressure. Also let $g h$ be parallel to E F, and let $f m$ represent the increase of pressure produced during Process 2. Then the straight lines $e f$ and $g h$ will be the lines of pressure for Processes 1 and 3; and for the other two processes, the lines of pressure will be some curves which would extremely nearly coincide with the straight lines $f g$ and $h e$. For want of experimental data, the natures of these two curves cannot be precisely determined; but, for our present purpose, it is not necessary that they should be so, as we merely require to find the area of the figure, $e f g h$, which represents the work developed by the engine during one complete stroke, and this can readily be obtained with sufficient accuracy. For, even though we should adopt a very large value for $f m$, the change of pressure during Process 2, still the changes of volume $g m$ and $h n$ in Process 2 and Process 4 would be extremely small, compared to the expansion during the freezing of the water; and from this it follows evidently, that the area of the figure $e f g h$ is extremely nearly equal to that of the rectangle $e f m n$, but $f e$ is equal to F E, which is ·087 feet. Hence the work developed during an entire stroke is $·087 \times p$ foot pounds. Now this is developed by the descent from 0° to $-t°$ of the quantity of heat necessary to melt a cubic foot of ice; that is, by 4925 thermic units, the unit being the quantity of heat required to raise a pound of water from 0° to 1° centigrade. Next, we can obtain another expression for the same quantity of work; for, by the tables deduced in the preceding paper from the experiments of Regnault, we find that the quantity of work developed by one of the same thermic units descending through one degree about the freezing point, is 4·97 foot pounds. Hence, the work due to 4925 thermic units descending from 0° to $-t°$ is $4925 \times 4·97 \times t$ foot pounds. Putting this equal to the expression which was formerly obtained for the work due to the same quantity of heat falling through the same number of degrees, we obtain

$$4925 \times 4·97 \times t = ·087 \times p.$$

Hence
$$t = ·00000355\, p \text{..........................(1).}$$

This, then, is the desired formula for giving the freezing point $-t°$ centigrade, which corresponds to a pressure exceeding that of the atmosphere by a quantity p, estimated in pounds on a square foot.

To put this result in another form, let us suppose water to be subjected to one additional atmosphere, and let it be required to find the freezing point. Here p = one atmosphere = 2,120 pounds on a square foot; and therefore, by (1),

$$t = ·00000355 \times 2120,$$

or
$$t = ·0075.$$

That is, the freezing point of water, under the pressure of one additional atmosphere, is $-·0075°$ centigrade; and hence, if the pressure above one atmosphere be now denoted in atmospheres,* as units, by n, we obtain t, the lowering of the freezing point in degrees centigrade, by the following formula,

$$t = ·0075\, n \text{....... ....(2).}$$

[The phenomena predicted by the author of the preceding paper, in anticipation of any direct observations on the freezing point of water, have been fully confirmed by experiment. See a short paper, published in the *Proceedings of the Royal Society of Edinburgh* (Feb. 1850), and republished in the *Philosophical Magazine* for August, 1850, under the title, "The Effect of Pressure in Lowering the Freezing Point of Water experimentally Demonstrated. By Prof. William Thomson."]

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RECENT PATENTS.

PREPARATION OF TEXTILE MATERIALS, AND FINISHING OF WOVEN FABRICS.

T. L. Paterson, Esq., *Glasgow.—Enrolled Feb.* 22, 1851.

Mr. Paterson's invention embraces three several heads of improvement in textile mechanism; and relates, in the first place, to a modification of the winding machine, such modification having for its object the securing of increased exactness in the building of the cop.

The horizontal traverse-rod which guides the yarn in the course of being wound upon the range of spindles in the machine, carries a series of short balanced levers, one for each winding spindle. Each of these levers is balanced upon a centre, and underneath its long end the yarn or thread from the hank is passed on its way to the spindle, bearing up this end in its passage. So long as the thread bears up the end of the lever, the opposite short end of the latter comes in contact, at every vertical rise of the traverse-rod, with a second lever set at right angles to, and above it. This lever also turns on a centre, and its opposite end carries a catch or detent working into the teeth of a small ratchet-wheel, placed on the stud-shaft of a small worm. The latter gears with a worm-wheel on a vertical or inclined shaft, the lower end of which has upon it a scroll-disc, or worm, of large pitch. This worm bears up the footstep of the winding spindle, which is caused to rise or fall by the revolution or partial revolution of the worm or scroll-disc.

During the proper action of the machine, the balance lever being held up by the passing thread, thus shifts the scroll-disc round very slightly at each rise of the traverse-rod or guide for the yarn, causing the spindle to descend a short distance at each movement, in order to effect the proper building up of the yarn. Should the thread break, then the lever being no longer held up by the pressure of the thread, ceases to act upon the gearing of the scroll-disc, so that the winding spindle descends no further, but remains at the exact height at which it stood when the thread gave way. Each spindle having a separate traverse apparatus, the breaking of one thread acts upon that spindle only. The effect of this contrivance is, that however frequently the thread may break, the building action of the cop is not interfered with, whilst, at the same time,

* The atmosphere is here taken as being the pressure of a column of mercury of 760 millimetres; that is, 29·92, or very nearly 30 English inches.

the yarn on the cop is not injured in any way by the frictional pressure of the cones or other apparatus ordinarily used for this purpose, as the stop action entirely arises from the absence of the thread from the end of the balanced lever, and the yarn is not in the slightest degree affected by it.

The second portion of the invention relates to a modification of the stuffing-box usually employed for connecting the fixed steam-pipes with the revolving hollow spindles of the copper cylinders of dressing or sizeing machines. Instead of using an ordinary stuffing-box for this purpose, the friction caused by such contrivance is obviated, by the substitution of flat or conical faces upon the ends of the fixed and revolving tubes. The projecting conical face may either be upon the fixed or revolving pipe, and the two surfaces are pressed together, so as to be steam-tight, by a slight spring.

The third branch relates to an improved finishing machine. In this arrangement, a set of flexible steel belts have upon them a line of stenter points for carrying the selvages of the fabric to be finished, and these belts are guided in their finishing movement by a series of guide pulleys, running in angular grooved guides. When the fabric is drawn along this machine, the grooved guides, acting upon the pulleys of the flexible belts, give to the latter a continuous series of horizontal angular movements, corresponding to the angles of the guides; and each selvage of the fabric being held on the pins of the belts, the warp of the piece receives a similar series of angling movements. In this way the warp is continuously angled throughout the machine, without the use of transverse-rods passing across the piece. By a simple contrivance, no additional mechanism whatever is required for compensating the stretch of the fabric under the angling action, as in all other machines of this class, where an additional compensating movement is essentially necessary, in order to prevent injury to the piece when angularly stretched. The peculiarity of the present contrivance consists in making each link of the stenter chains carrying the fabric, slightly *less* than the *angular* length of each incline of the grooved guides. In this way, a totally new principle of compensation is introduced, the action of the linked chain or flexible belt being, in fact, its own compensator. As originally devised, the machine was made with a single link and guide pulley to each incline of the angular grooved guides; but in working, it was found that the angling action was very imperfect at each joint of the links, about an inch across the piece, at each joint, being left unbroken, and in its original stiff state. To remedy this, two links and pulleys were adjusted for each length of angle, so that the fabric is now angled equally in every part.

This system of finishing is now in active operation; and, whilst the production is very great, the result in point of finish is of a superior character.

DOCKS AND SLIPS.

James Scott, *Shipwright, Falkirk.—Enrolled March* 20, 1851.

The very valuable improvements specified under this patent, comprehend four general heads,—an arrangement of a hydrostatic dry dock—an improved "arm" for the carriages of slips—hydrostatic keel-blocks for supporting vessels in dock or on slips—and a steam-heated pan for boiling pitch. In the side of the river, or harbour, is formed a recess of sufficient capacity to receive the largest vessel to be lifted, and on each side of this recess is erected a row of piles, placed two and two, and projecting high enough to carry a long hydrostatic lifting cylinder between each pair. These cylinders rest on the heads of the piles by top flanges, and the cylinder rams are fitted with saddle-heads to fit under bent connecting-rods supporting the elevating platform of the ship beneath. Water being pumped into each of the cylinders, the two ranges of rams simultaneously rise, and thus elevate the vessel, which is supported by keel-blocks and shores on the platform. When elevated to the proper height, the carriage is run on to the platform to receive the vessel, and the whole is then traversed off landward for repair, by another arrangement of hydrostatic cylinders.

The improvement in the "arms" of slips consists in attaching them by joint-bolts to the timbers of the carriage, so that, when the latter is to be run beneath the vessel, the arm may be conveniently laid parallel with the timbers, presenting no obstruction to the passage of the carriage. By this plan the arms are never disconnected from the carriage, and hence a very great source of inconvenience is removed.

The hydrostatic keel-blocks for supporting vessels when received on the slip, present a beautifully ingenious mode of obviating all risk of straining the vessel when removed from the yielding bosom of the deep, to a hard and, perhaps, uneven bearing surface. Instead of a solid block of wood, Mr. Scott adopts a short hydrostatic cylinder, fitted with a ram, just as in an ordinary pressure apparatus. These cylinders are all connected by a water-pipe, so that when a vessel's keel comes to rest upon a line of them, they give an equal support to the entire keel. If the keel is what shipwrights term "hog-backed," then the convex portions, pressing first on one or two rams only, force water into the others, which are yet out of reach of the concavity of the keel. In this way, however irregular or uneven the keel-line may be, an equal support is obtained throughout. The steam-heated pan is simply a double vessel, with a steam space between for the admission of the heating steam.

We propose to illustrate these valuable improvements very fully in a future number.

REGISTERED DESIGNS.

TOURIST'S POCKET UMBRELLA.

Registered for Messrs. Wilson & Matheson, *Glasgow.*

To the careful man, who carries an umbrella as a guard against "a rainy day," it is frequently matter for serious consideration whether the advantages of this cover in a storm, are not counterbalanced by the inconvenience of being loaded with a useless article in fine weather. Messrs. Wilson & Matheson's "Pocket Umbrella," as its name indicates, discloses a remedy for this objection, for it may be packed in a corner of a portmanteau, or stowed away in a moderate-sized pocket. This extreme portability is secured by making the supporting ribs of the cover with a central joint, so that they may be folded into half the length occupied when the umbrella is expanded. Fig. 1. of our engravings

Fig. 1.

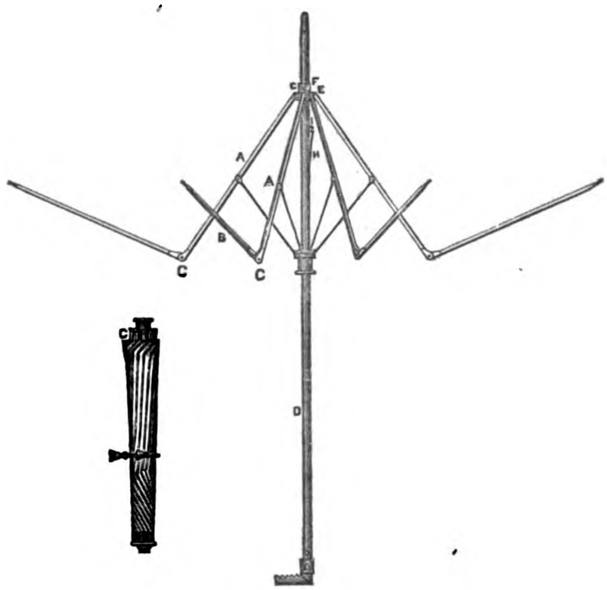


Fig. 2. 1-12th.

represents the framework of the umbrella as partially opened—the jointed halves of the ribs being turned slightly back. Fig. 2 shows it in its completely closed state, fit for carrying in the pocket.

Each of the ribs is in two pieces, A, B, connected by a metal joint at C, so as to permit of the outer half, B, being folded back to lie parallel with the other, A, then occupying only half the length taken up in the fully opened state. When opened, the umbrella presents an appearance exactly similar to that of a common umbrella. To close it, the handle or stick, D, is removed from the ferule or ring, E, carrying the ribs, by turning it a short distance to permit of the egress of the pin, F, fast in the stick, from a ring groove in the ferule, the pin sliding out by the short groove, G. The stick may then be used as an ordinary walking-stick, whilst each outer half of the ribs is turned back or folded down by its joint, the remaining halves being closed down in the usual way, so as to bring the umbrella to the portable form represented in fig. 2.

To afford greater security in holding up the ribs and cover when the umbrella is opened, the metal catch, H, is substituted for the ordinary bent wire. This catch is of flat metal, turning on a joint in the stick, and pressed out by the spring beneath, whilst a hollow or slight indentation, I, on the top of the catch, affords a good hold for the ferule. When the

stick is used as a walking-stick, the metal catch, H, may be held in its groove, so as not to project, by the little spring-hook, I.

Umbrellas are also made on the same principle, with jointed sticks or handles, so that, when closed, the whole may easily be laid in a trunk.

TRITURATOR.

Registered for MR. J. S. MACKENZIE, *Engineer*, *Newark-upon-Trent.*

This apparatus, called by the inventor the "Mackenzie Triturator," is intended to perform the heavy pestle-and-mortar and other mixing operations involved in the manufacture of printer's ink, ointments, and paints, and for the several processes of frictional mixing, with which the druggist's apprentice is, unfortunately for himself, too familiar. The abrading or triturating action is performed by a pestle, with an ingeniously-arranged differential motion, which we shall describe with the help of our three illustrative figures:—Fig. 1 is a front elevation of the triturator, showing the pestle and actuating gearing; fig. 2 is a corresponding side elevation; and fig. 3. is a detail of the gearing for the differential movement of the pestle. The mortar, A, is seated in the base of a timber frame, B, the upper part of which carries the driving shaft and connections. The pestle has a long rod passed at C, through a universal joint in a weighted lever, arranged to give the proper pressure to the pestle. The top of the pestle-rod is inserted into a small sliding

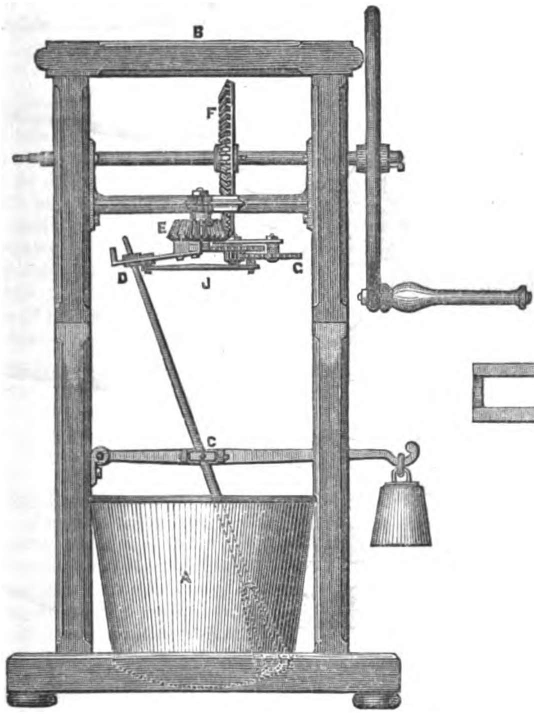


Fig. 1.

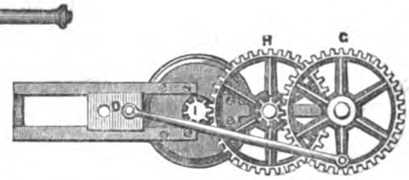


Fig. 3.

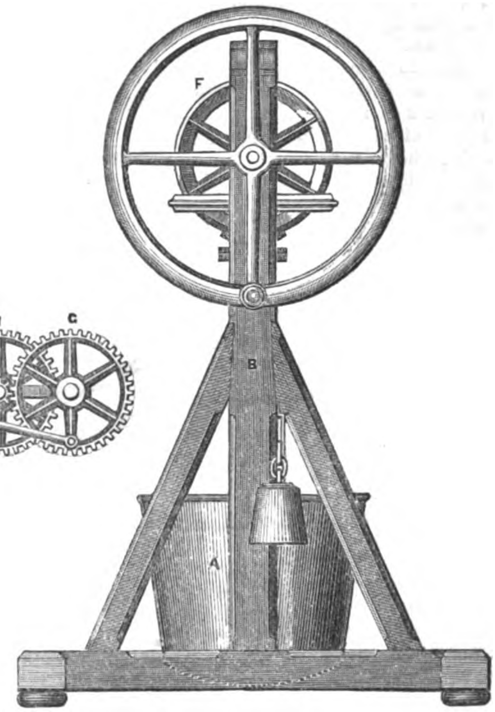


Fig. 2.

block, D, grooved to slide along a short guide bar, as shown in the detail, fig. 3. This bar is fixed to the side of the bevel-wheel, E, running loose on a vertical stud, and driven by the large wheel, F, fast on the driving shaft, which receives its motion from a winch-handle. A spur-wheel, G, runs on a stud carried by an arm attached to the wheel, E, and gears with a pinion on the shaft of the spur-wheel, H, which latter gears with a stationary pinion, I, fast on the stud centre of the bevel-wheel, E. A rod, J, connects the block, D, to a pin in the face of the wheel, G, and thus the revolution of this wheel causes the rod of the pestle to be continuously traversed back and forwards across the centre line of the wheel, E, directly over the centre of the mortar beneath. This gearing involves the principle of the old "sun-and-planet" motion, and gives to the pestle a most effective rubbing action, in a compound revolving and traversing movement.

The inventor informs us that his original idea in contriving this triturator, was to provide some more effectual plan for grinding sheep ointment, but its success has led to its extended use for all triturating and levigating operations.

ROTATORY BOOT AND SHOE CLEANER.

Registered for MR. C. F. T. YOUNG, *Stokeley Pomeroy, Devon.*

It has been frequently suggested that the common manual process of shoe-cleaning might be judiciously handed over to mechanical apparatus, but the idea hitherto seems to have lain dormant. Mr. Young's contrivance offers one form of its embodiment in actual mechanical details, and this arrangement we now illustrate in two views. Fig. 1 is a side elevation of the cleaner, and fig. 2 is a corresponding front view. It consists of two neat cast-iron side standards, fitted up with a large band pulley and driving treddle, just as in a portable lathe. A, B, Are the two circular brushes, fitted on a horizontal spindle, carried in bearings in the top of the standards, and driven from the pulley beneath by a light endless band. One brush, as a matter of course, removes the mud, whilst the other gives the polish. A small drawer at C, holds the necessary

Fig. 1.

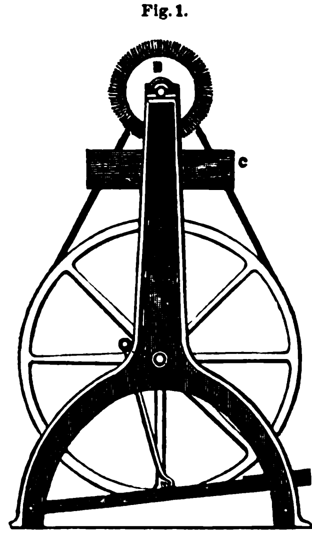
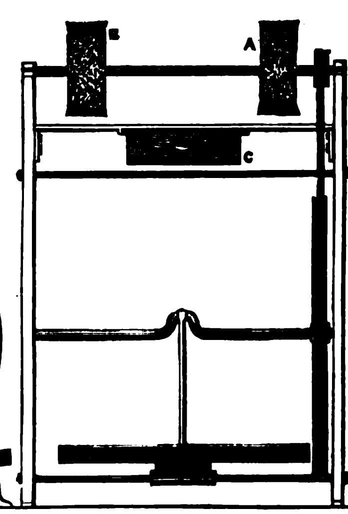


Fig. 2.



adjuncts. In large establishments, such a machine would be found a great convenience in getting expeditiously through a branch of labour which presses heavily on domestic servants.

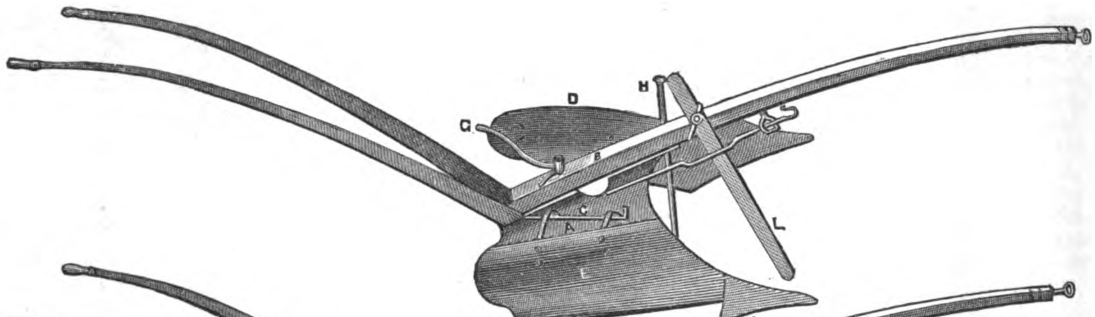
THE BIX HILL-SIDE PLOUGH.

Registered for Mr. William H. Hopkins, *Bix, Oxfordshire.*

Mr. Hopkins' improvement in ploughs consists in the employment of two turn-furrows, in order to facilitate ploughing on a hill side. By the use of two turn-furrows, the furrow may be formed in a horizontal plane on the hill side,—the plough, at each change in the direction of travel, being adapted so as to throw the soil in all cases down the hill. Fig. 1 represents a side view of the plough, with the near turn-furrow down against the land side, A, and the off turn-furrow raised. Fig. 2 is a like view, with the turn-furrow in an opposite position. A, Is the land side, which is fixed to the plough beam, B, in the ordinary manner. Joint-pins, C, are fixed by knuckles to the land side, by which the turn-furrows, D E, are secured, and hinged thereto by brackets. The turn-furrow in fig. 2 is retained in its elevated position by a hook, F, which is double—one being on either side of the plough, both being moved by the hand-lever, G, so that the one turn-furrow is secured, while the other is released by moving the hand-lever to opposite sides. The turn-furrow in position for ploughing, and the land side, as seen at fig. 2, is secured by a pin, H, which fits into a hole in a prong or bolt, I, that passes through an opening in the land side, A. A similar projecting piece of the turn-furrow, E, passes through the same hole in the land side, and is secured in like manner by the pin, H, being placed on the other side of the land side. Each turn-furrow is furnished with a share, K, which fits on a dovetailed projection attached to the end of the turn-furrow. By this arrangement of a plough, in ploughing along the side of a hill the turn-furrow is lowered that will throw the soil down the hill; and on reversing and travelling in the opposite direction, the other turn-furrow is used, so as to throw the soil in the same direction, thereby rendering the plough of great additional utility, it being impracticable to throw the soil up the hill, which therefore precludes ploughing in both directions by the ordinary plough with one turn-furrow. In using two shares and turn-furrows as described, it is necessary that the coulters should be carried towards the turn-furrow not in use, which is effected by a square eye encircling the head of the coulter, L; this is furnished with a screw stem, which fits the boss or nut of the handle. The nut is dropped into a bracket, which is formed to retain the nut in position; and accordingly, as the square is pressed on either side by turning the handle, the coulter, L, will be inclined in the opposite direction, and at the same time securely fixed in position.

It is stated that nearly twice as much work may be done by this implement as by the old plough, working up and down the hill sides.

Fig. 1.



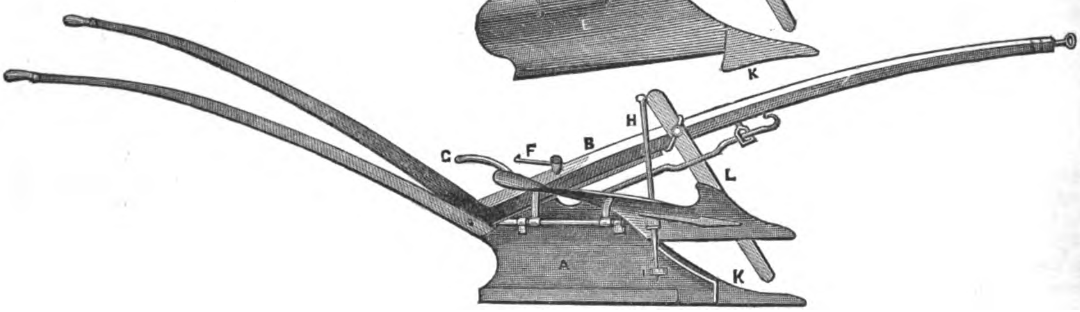


Fig. 2.

PAINTER'S BRUSH.

Registered for Mr. W. Merritt, *Painter, Onslow Square, London.*

Mr. Merritt's brush, as illustrated in the three figures annexed, is a vast improvement upon the old system of affixing the bristles to the handle; for whilst greatly superior durability is obtained by it, the painter is not subjected to the constant perplexity of finding the bristles mingling with the coating which he is laying on with them. Fig. 1 of our engravings represents an elevation of the brush complete; fig. 2 is a vertical section of the brush; and fig. 3 is a corresponding section of the handle and bristle-holder detached. Instead of a mere tapering piece of wood, the handle, A, is formed with a swell at its upper end, B, to enable the operator to obtain a better hold upon it. To the expanded lower end, A, is screwed a metal case, C, or bristle-holder, its open end being narrower than the part at which it is screwed to the handle, thus giving inclined surfaces, the better to secure the bristles, D, which are additionally held by a layer of cement laid in between the end of the wooden handle and the thick ends or roots of the bristles, as indicated by the dark line in fig. 2. This arrangement provides very great firmness of hold for the bristles, insomuch that, when the brush is worn half-way down the length of the bristles, it is not rendered useless, there being still a compact range of bristles for use, in place of a mere rim of bristles with a hollow centre, as occurs in the common brush. It may also be remarked, that neither the action of fluids, nor the heat of the sun, has any effect in loosening or disintegrating the bristles.

Fig. 1.

Fig. 2.

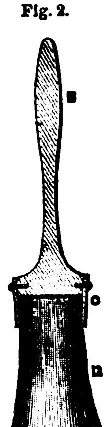
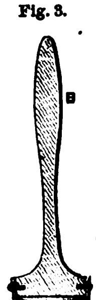


Fig. 3.



MILITARY, TOURIST'S, AND EMIGRANT'S PORTABLE COUCH OR BEDSTEAD.

Registered for John Blair, *Esq., Younger of Camphill, Irvine, Ayrshire.*

This is a very clever adaptation of light angle-iron in the construction of the framing of portable beds and couches, whereby not only is extreme portability secured, but also peculiar facilities for erection and removal, whilst the constructive details possess great strength with little material. Fig. 1 of our engravings represents a side elevation of the iron frame of a couch of this construction, as erected for use; and fig. 2 is an end elevation of the frame to correspond. The two side frames, A, are of angle-iron, with a central folding-joint at B, the support for these sides being obtained from the inclined flat-iron bars, C, hinged to them at D; a thumb-screw being passed through the two bars at the point of intersection, E, to hold them together. The transverse end frames, F, also of angle-iron, are each in one piece, and are attached by their extremities to the corresponding ends of the sides, A, by thumb-screws, G, to form a rectangular frame. These ends are also supported by inclined flat-iron bars, H, hinged to them at I, and held together by thumb-screws, J. Fig. 3 represents one of the end pieces in detail, with its supporting legs folded in for packing, each bar of the legs being laid down parallel with one flange of the angle-iron. Fig. 4 is a corresponding view of the same parts, at right-angles to fig. 3. Fig. 5 is a detail of one of the side frames, A, folded up by its joint, its legs being folded in

to lie within the space enclosed by the flanges of the angle-iron; and fig. 6 is a corresponding view at right angles to fig. 5, showing the space into which the whole frame is folded for removal. By the use of angle-iron for the main frame, great strength is obtained, with little weight, whilst the space included between the side-flanges of the angle-iron, admits of packing or compressing the legs or supports therein.

Fig 1.

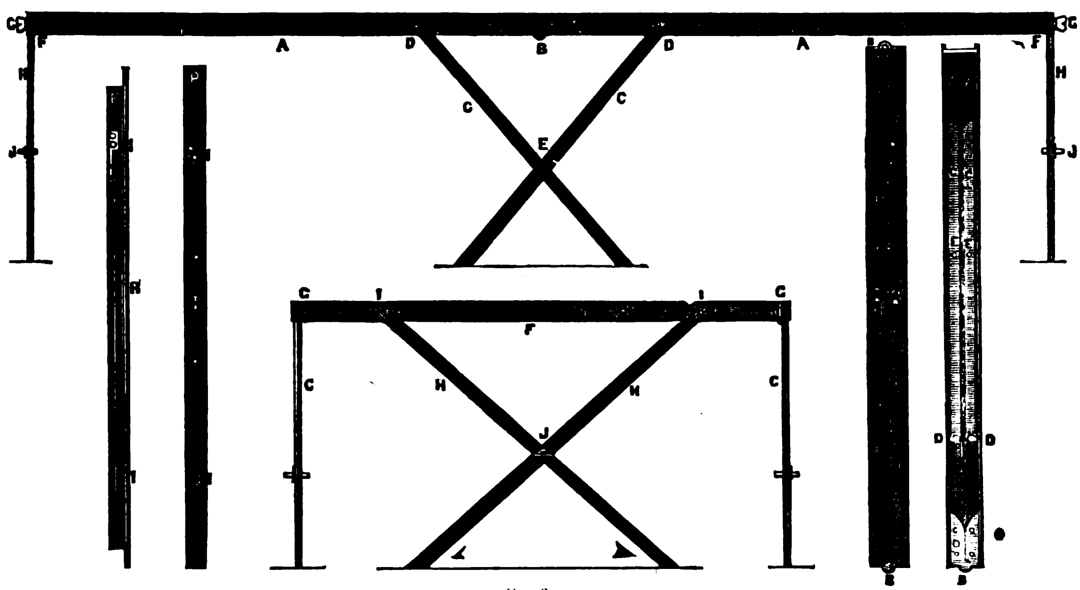


Fig. 3. Fig. 4. Fig. 2. Fig. 5. Fig. 6.

7-8th inch = 1 foot.

The ticking or stretched fabric carrying the bedding, is formed with side and end seams or loops, which are slipped upon the side and end frames previous to erection and screwing up, thus forming an especially easy mode of attachment. Light rods may be added, if necessary, to carry curtains.

The peculiar lightness of this frame, with its great ease of stowage, will render Mr. Blair's invention a most acceptable one for all whose avocations lead them to "camp out." With this bed, and a stout tent overhead, the traveller or sportsman may lay his head where he lists, in comfort and security. Although the dimensions may be correctly made out from our engravings, yet we may perhaps assist the conceptions of the reader as to the smallness of its bulk when packed, by mentioning that fig. 7, containing the whole frame, measures only a little more than three feet in length, its section being $2\frac{1}{2}$ inches square.

TABLE-KNIFE WITH INVISIBLY SECURED HANDLE.

Registered for Messrs. Hilliard & Chapman, *Cutlers, Glasgow.*

By this simple arrangement—the invention of Mr. Harvey Hilliard, of the firm of Hilliard & Chapman—perfect security of attachment of the handles to the tangs of table-knives is obtained, without involving the use of any visible fastenings whatever, whilst, unlike other contrivances for a similar purpose, the handle is removeable with great facility when required for repair or renewal. We give three illustrative views of the plan. Fig. 1 is a side view of an ordinary table-knife, showing the tang dotted inside the handle. Fig. 2 is a corresponding edge view of the blade and tang, with the handle removed—taken at right angles to fig. 1; and fig. 3 is an end elevation of the handle detached, showing the hole for the admission of the tang.

The tang, A, of the blade is forged with parallel sides, except at the extreme end, which is flattened out, so as to form two projecting shoulders, B B, on opposite sides. The handle, C, is bored out to admit the parallel portion of the tang, the bore being too narrow to receive the shoulders, B B. On each side of the bore a longitudinal groove, D D, is formed in the handle, the diametrical length across from the bottom of each groove being equal to the breadth across the tang at the two shoulders, B B, whilst the width of the grooves is sufficient to receive the thickness of the shoulders. At the proper depth in the handle, a circular excavation, or widened bore, E, is made in the handle, of a diameter sufficient to receive the widened end of the tang, or about equal to the dimension across the bore to the bottom of the grooves, D D. In attaching the handle the tang is entered into its bore, the shoulders, B B, sliding

Fig. 1. Fig. 2.

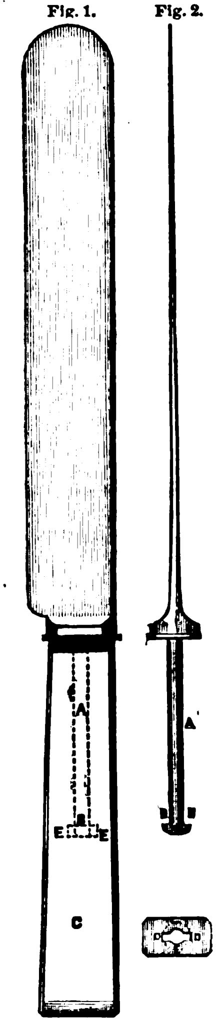


Fig. 3.

down the grooves, D D. When entered up to the shoulder of the blade, the shoulders, B B, being clear of the grooves by being received into the excavation, E, the handle is turned partially round to bring the grooves out of the line of the shoulders. When so turned, the handle and tang become locked together by the catching of the shoulders, B, against the solid shoulder formed at the end of the bore in the handle, and the handle is then secured in its position by the introduction of cement into the bore. When the handle is to be removed, the cement is softened by heat to allow the handle to be turned to bring the grooves into a line with the shoulders, B, when the parts may be separated.

In the only other existing mode of invisibly securing knife-handles, the attachment is so firmly effected that removal is rendered impossible, and hence arises a very great inconvenience, which, in Mr. Hilliard's plan, is entirely obviated.

CORRESPONDENCE.

THE USE OF ESCAPE GASES FROM BLAST FURNACES.

Since the introduction of the hot-blast for making pig-iron, there has been nothing decidedly new introduced into the manufacture, until the modern applications of the escape gases from the blast-furnace to various heating purposes. A successful example of one system of applying these gases, namely, to the heating of the air-blast, is to be seen at the Dundyvan Iron Works. Mr. Mackenzie, the manager, draws off the gases by suitable holes and channels in the furnace, with the assistance of a large chimney—igniting the current at the point where the air-pipes are placed. This arrangement has produced results sufficiently encouraging to tempt many other iron-masters to adopt it. The quantity of gas tapped off in this way far exceeds that necessary for heating the air, and the balance is carried to the use of the blowing-engine boilers, for raising steam, instead of coal. A third use, and in my idea by far the most valuable of the applications of the gases, is the calcining or roasting of clay-band ironstone. The furnaces now in use in Lanarkshire, use no other ore than the black-band, an ore that calcines itself without the aid of coal. But it is well ascertained that this ore is being rapidly exhausted. When the supply fails, we shall be compelled to go to some distance for

the clay-band ore, of which immense quantities are found between the coal measures and the limestone. The drawback to the extended use of the clay-band, is the great expense of working it, and the additional amount of coal and labour for calcining it. As I have had some experience with the clay ironstone, I am able to state that it takes 3 tons 4 cwt. in the raw state to produce 1 ton of pig-iron, and this quantity requires, for open calcination, —

1 ton of coals, - - - - - - -	2s. 6d.
Labour, $3\frac{1}{2}$d. per ton, - - -	11d.
Cost of calcining, - - - - - -	3s. 5d.

Now, at Coltness Iron Works, the other day, I saw the ironstone being calcined with the gas carried off from the furnace, as before described, in a brick-kiln, 18 feet in diameter, and 10 or 12 feet in length, and made to hold about 140 tons. Five days afterwards, I again went to Coltness, and found the ironstone most thoroughly and regularly calcined throughout, and entirely free from being run—to which ironstone is liable in stormy weather, when burned in open kilns. Mushet, in his book on the making of pig-iron, states that all clay ironstones absorb, when calcining, about 18 per cent. of oxygen; so that, by calcining the ironstone in close kilns with the gas, and where the atmosphere is excluded, a farther saving of coal takes place in the furnace; and the manager of the Coltness Iron Works says that he has found this to be correct.

These late improvements, then, form a step in the right direction, to keep down the expense of making iron, when the black-band ironstone gets scarce and dear.

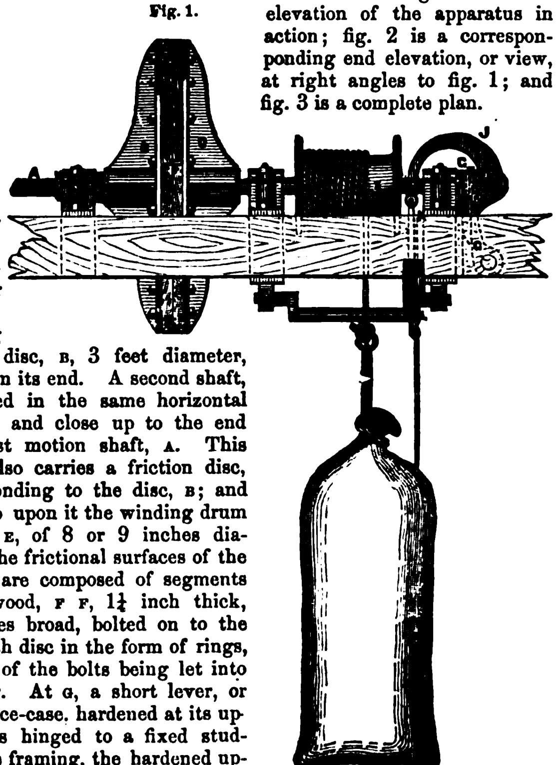
William Marshall.

Glasgow, March, 1851.

SELF-ACTING ELEVATOR OR HOIST.

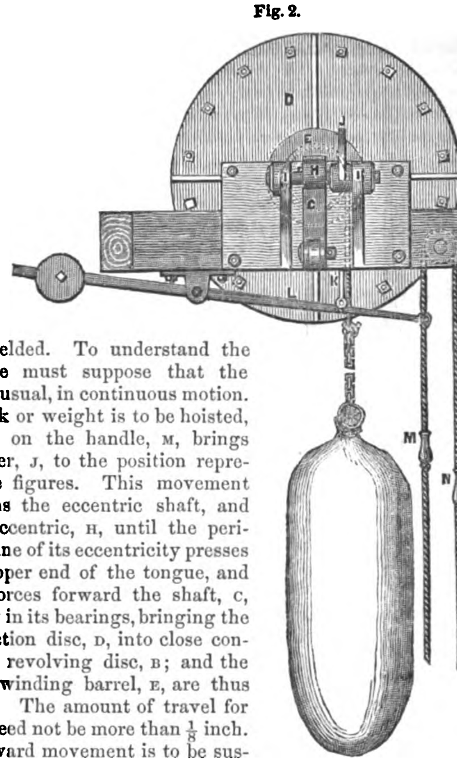
My three illustrative sketches represent an arrangement of hoist or elevating apparatus, containing some features of importance, which, I think, will be new to the majority of your readers. It is peculiarly simple and compact in structure, and I may fairly claim for it the valuable property of non-liability to derangement. It may be used with equal facility for *raising* and *lowering*. In the sketches, it is represented as raising corn sacks. Fig. 1 is a side elevation of the apparatus in action; fig. 2 is a corresponding end elevation, or view, at right angles to fig. 1; and fig. 3 is a complete plan.

Fig. 1.



The first motion or driving shaft is at A, running at from 35 to 40 revolutions per minute, and having a friction disc, B, 3 feet diameter, keyed on on its end. A second shaft, C, is placed in the same horizontal axial line, and close up to the end of the first motion shaft, A. This shaft, C, also carries a friction disc, D, corresponding to the disc, B; and it has also upon it the winding drum or barrel, E, of 8 or 9 inches diameter. The frictional surfaces of the two discs are composed of segments of beech-wood, F F, $1\frac{1}{4}$ inch thick, by 4 inches broad, bolted on to the face of each disc in the form of rings, the heads of the bolts being let into the timber. At G, a short lever, or tongue piece-case, hardened at its upper end, is hinged to a fixed stud-bolt in the framing, the hardened upper end being set immediately behind the back end of the shaft, C. This tongue is acted upon by the periphery of an eccentric, H, on a shaft carried in the bearings, I I; and the same shaft has keyed upon it the carved lever, J, the opposite end of which is connected by a wire, K, with the stop-lever, L. The handles M and N, on the two pendant ropes in fig. 2, are the starting and stopping handles.

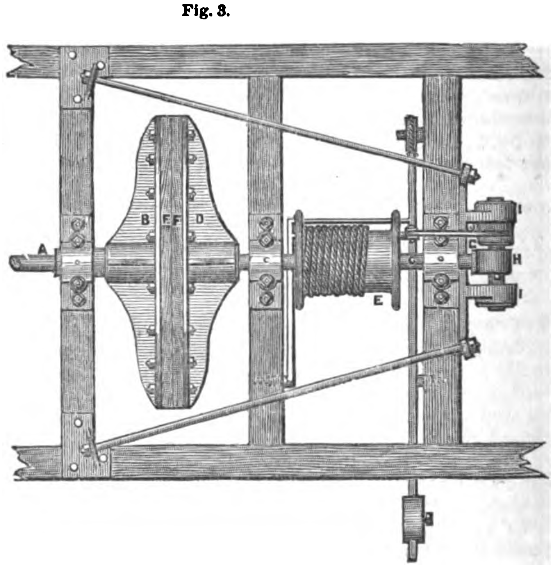
Fig. 2.



The shaft, C, enters a short distance into the eye of the disc, B, to insure concentricity and steadiness, and on its back end, acted on by the tongue G, a piece of steel is welded. To understand the movement, we must suppose that the shaft, A, is, as usual, in continuous motion. When the sack or weight is to be hoisted, a slight pull on the handle, M, brings down the lever, J, to the position represented in the figures. This movement partially turns the eccentric shaft, and with it the eccentric, H, until the periphery in the line of its eccentricity presses against the upper end of the tongue, and through it, forces forward the shaft, C, longitudinally in its bearings, bringing the stationary friction disc, D, into close contact with the revolving disc, B; and the shaft, C, and winding barrel, E, are thus set in motion. The amount of travel for this purpose need not be more than $\frac{1}{8}$ inch. When the upward movement is to be suspended, and the sack let fall, the handle, N, is to be pulled, to raise the lever, J, when the frictional contact ceases.

By working the two handles, M N, in conjunction, the amount of frictional pressure between the two discs may be regulated with the greatest nicety; even a body descending with the full force of gravity may be checked within a few inches from the ground. It will be seen, from the engravings, that should the ascending body not be checked in sufficient time, the hoisting movement will stop at the top of its lift of its own accord, by the action of the projection on the rope upon the stop-lever, L.

Fig. 3.



I. Whitesmith.

Glasgow, Feb., 1851.

THE REACTION SYSTEM OF STEAM-BOAT PROPULSION.

It is with considerable reluctance that I am induced to take some notice of Mr. Purkis' communication in your last number, relative to my patented improvements in the propulsion of steam-vessels, by way of vindicating them from the thoughtless reflections he has made on them, and of setting him right as to the contents of my specification. He has a most alarming taste for misquotation, and inversion of "true intent and meaning;" and the certain and uniform consistency with which he misbehaves in this way, may impose on your general readers, who would probably construe silence on my part into the honest consciousness of a bad cause.

But the thing is not so ordered; and to give force to my quotations from my specification, I must quote Mr. Purkis' words too, and what is more, I shall quote them literally. He says: "I have carefully read Mr. Ruthven's specification throughout, accompanied by an experienced man, well qualified to judge." Very good to begin with, as herein Mr. Purkis virtually disclaims his ability to judge for himself. He adds, that a mode of propulsion was patented in May, 1850, by Messrs. Callaway and Purkis, and that "ours (the mode now referred to) is an adaptation of Appold's centrifugal pump. Mr. Ruthven's pump will not do near the duty of Appold's, and why should it do more as a propeller?" Mr. Purkis may be an authority, but I have some doubts on this point. Now here is the account of my propeller from my specification: "The wheel has blades, or floats, placed between two discs, or circular plates, extending to the extremity of the blades, made of a conical shape, with an aperture at the side next the canal, nearly the size of the aperture of the cone, and having the (metallic) ring to fit the disc at the aperture more closely, and by lying so loosely on its bed, that, should the wheel be made to revolve a little to one side or other, it would carry the ring with it, so that the wheel might revolve pretty nearly water-tight at that place, with little or no friction." After having no doubt read this portion of my specification, in company with his intelligent friend, Mr. Purkis, with remarkable courage, obliges your readers with the following critical observations. "It is clear, that the pressure generated in the case of the propeller (Ruthven's), would cause the water partly to return from where it entered, were it not for some provision to the contrary. Mr. Ruthven accomplishes it by means of india-rubber rings, adjusted by screws to the orifice of the inlet of the revolving apparatus; we, by bringing a metallic surface as near as practicable to the inlet of the revolver, without touching. Practice proves to us, that the leakage by this plan is not to be detected. Then why clog the machine with a brake, the loss of power from which must be enormous?" In this clause, not only has Mr. Purkis said the thing that is not, which plainly appears by a reference to the previous quotation from my specification, but he also stands convicted as a plagiarist. He has, in the first place, substituted in my machine india-rubber rings for a ring of metal; and, secondly, he has appropriated my metallic ring for his own use. In this creditable transaction there is more of liberty than liberality; though we can hardly be angry with Mr. Purkis, for, by his unconditional claims, he has rendered the task of refutation most comfortably easy.

Again, Mr. Purkis, with his usual felicity, describes the inlet of my apparatus as in the form of a long tank, about one-fourth of the length of the ship, one-third the breadth, and about one foot deep; having perhaps 200 holes, so contrived as to catch the water when the ship goes forward. Now for my description. The canal, or pipe (known as a tank by Mr. Purkis), may be of various dimensions, provided a free supply is obtained, and taken from either bow or stern, as the vessel can be propelled either way. This I think is all right; but as the drawings do not represent the length of the vessel, the ratio of one-fourth for the length of the inlet, is an assumption of a point which Mr. Purkis had not the means of obtaining. Again, had he counted correctly, he would have found exactly 76 openings for the admission of water, in place of 200—an unexampled example of the convenience of round numbers. He adds, that in virtue of the number and form of these apertures, I claim the existence of another power tending to propel the vessel, by water being sucked in through these openings; and accordingly, when he asks the unanswerable question, "Why all these openings, whose united area will amount to twenty times as much, or more, than the inlet of the propeller?" he answers, knowingly, that their object was, as he supposed, to increase the sucking surface. Now here again Mr. Purkis has shown that his education has been sadly neglected; his argument rests on the magnificent disproportion of twenty times, whereupon he converts it into sucking surface; whereas, the united area of the openings is only about *equal* to that of the inlet to the propeller. I do not claim "sucking surface," nor are these words used.

Lastly, I must correct the exclusive view that Mr. Purkis takes of the scope of my invention, when he states that I have patented my invention solely to discharge above the water-line, while he discharges below it. Now here is my claim: "First, for the combination of a centrifugal pump, constructed substantially as herein described," &c. "Second, for the bent or nozzle-pipe attached to the stationary pipe, and capable of motion in a vertical plane, by means of which the water may be discharged either fore or aft, up or down, with only one aperture, and without the use of valves."

Further, "the management of the nozzles may be on any part of the deck, or where most convenient; and they can not only be made independent of each other, but entirely independent of the steam, or other power employed to discharge the water, so that a vessel can be propelled ahead or astern, or stand still, or turn round, or to one side or other, without the necessity of reversing or stopping the engines, thus leaving the control of the motions of the vessel to those having the management of the nozzles; and should the rudder be lost or damaged, the vessel can be navigated without it, by attending to the nozzles."

With the assistance of the foregoing quotations from my specification, your readers will perceive that Mr. Purkis' story is a case of mere special pleading, and that of a very questionable character. Before long, I shall, I trust, be able to impart some of the very specific information on the practical performance of my propeller, which is desired by Mr. Purkis; in the meantime, it is quite plain, that after having carefully read the above-quoted parts of my specification, as well as the other matter there contained, Mr. Purkis, in conjunction with his cicerone, the wise man, could have had little difficulty in reciting the advantages of his own patent.

I have now only to hope that you will afford a column for this unpleasing but necessary vindication.

John Ruthven.

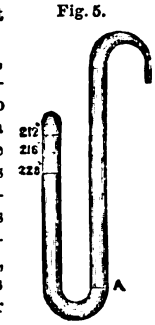
Edinburgh, March, 1851.

ON STEAM-BOILER EXPLOSIONS, AND SOME NEWLY-DISCOVERED PROPERTIES OF HEAT.

IV.

On one of these instruments being immersed in a fluid, while the small sealed end thereof was held at some distance below the surface of that fluid, the sealed end was broken off, and the instrument became instantaneously filled with the fluid in which it was immersed.

Fig. 5.



The first instrument being filled with dry mercury, as much of that metal was poured out from the unsealed end, as reduced the surface within that end to letter A, fig. 5; the instrument being then heated in a bath, the volumes of steam became apparent in the sealed end, in correspondence with the temperatures annexed thereto, showing that the volumes were proportional to those before obtained in other instruments at high temperatures, and that the very minute quantity of water still retained all its original properties, and therefore the water had been at high temperatures unaltered by contact with the mercury in those larger instruments.

The second instrument having been, in the same manner, filled with spirits of turpentine, no vapour was perceptible therein, till the instrument was heated to 316°, or boiling point of oil of turpentine.

The third instrument being treated in a similar manner with linseed oil, no vapour was perceived therein even when heated to 400°.

The foregoing experiments seem clearly to show, that while mercury possesses no overpowering attraction for water in a very minutely divided state, or sufficient to hinder the formation of natural steam therefrom, yet, on the contrary, both the oils of linseed and turpentine, when similarly circumstanced, possess such very powerful hindrances thereto, that spirits of turpentine prevent the formation of steam from water at 316°, which at that temperature would have a tension of more than 60 lbs. per inch, and linseed oil prevents the formation of steam from water at 400°, which at that temperature would possess the tension of more than 260 lbs. per inch.

Now this fixity of water so heated is strongly contrasted with a circumstance I have often witnessed, but never seen recorded. On withdrawing atmospheric pressure, by means of a very superior air-pump, from well-boiled cold fixed oils, the oil is resolved at common temperatures into black vapour or smoke, just as long as the perfect action of the air-pump is continued.

The foregoing experiment seems to indicate that the joint attraction of the compound chemical equivalents of oil for small quantities of water, is far superior at high temperatures, and under atmospheric pressure, to

the separate attraction of the chemical equivalents of oil for each other at common temperatures, when released from atmospheric pressure: so that, were there no atmospheric pressure, there could be no fixed oils, just as, if there were no atmospheric pressure, there would be no water at common temperatures.

To test the real value of the foregoing matters practically in some degree, two small working high pressure-engines were carefully constructed, and both exactly alike in every particular, except that the diameter of one cylinder of six inches was double the diameter of the other cylinder of three inches, and therefore of fourfold capacity.

These engines were alternately supplied with steam of the same tension, through separate pipes furnished with stop-cocks, and attached to the same tubular boiler over the same furnace, wherein the same quantity of fuel was consumed in the same time in both experiments.

Within the furnace, above the fire and beneath the boiler, was placed a coil of iron pipe to heat the steam in its passage from the boiler to the larger cylindered engine; the heating surface of this coil being equal to about one-fifth part of the heating surface of the tubular boiler. Each engine was furnished with a meter to number the revolutions thereof, and with one of Morin's dynometers for measuring and recording the actual working force or duty of the engine, at every instant of the experiment.

Experiments were made and separately repeated with these engines, in the presence of highly respectable and competent engineers, when it was found, when the engines were successively run at the same speed, that the same quantity of fuel produced more than four times greater effect, when the steam employed in the larger cylinder was heated in its passage thereto, through the heated coil of pipes, than a similar quantity of fuel produced in the smaller engine with the unheated or natural steam of the same exact tension; while in both cases all the steam the boiler could supply was employed. The inference then seems unquestionable, that more than four volumes of elastic fluid of equal tension was produced from the same fuel, and effectively employed in one case, than was produced in the other case, and from a smaller quantity of water also. For it is evident, that as a part of the heat in one case was intercepted in its passage from the furnace to the boiler, by the coil of iron pipe employed to heat the steam in its passage to the larger engine, much less heat could only then be employed to convert the water to steam in the boiler, and therefore there must of necessity have been less water evaporated therefrom during that experiment.

As it appears in the diagrams how comparatively great is the initial expansion of steam by heat, which initial expansion is unused, wasted, and cannot be employed in high-pressure engines, it as evidently follows, though high-pressure engines are thus capable of immense improvement, yet in their very nature they are incapable to obtain the full advantage of this improvement, and can dispense but a portion of the benefits to be derived from this discovery, by which the power of mankind over matter may be so inexpensively and so immensely increased.

The wonderfully, nay, we must say the miraculously distinctive and peculiar qualities of either or both these elastic fluids, in equal volumes of equal tension and equal mercantile value, will be found collected in the following table, and must fill the mind with astonishment.

Steam	*Stame*	each under atmospheric pressure or tension.
Eight	one	equivalents of water.
Eight	one	equivalents of caloric.
12	24	distances of and in dimension of the diameters of

atoms of water from each other at the tension of 30 inches mercury, assuming the distances probable, from the general laws of atomic combination and other previous calculation; which shows that, while water is increased 1700 fold in steam, it is increased 13,600 fold in stame under atmospheric pressure, and by the same quantity of caloric at the temperature of 650°.

To the foregoing miraculous distinctions we have to add another equally curious and distinct affinity discovered to exist between caloric and water in stame, and which new property alone would constitute stame an atomic chemical compound distinct from steam, were there no other distinction whatever between them, and which peculiar property of stame must hereafter prove of great value in many economical applications of heat.

To comprehend this new and useful fact, it is necessary to recollect the temperature of steam is always found to be in strict accordance with its density—tables whereof have been published by Taylor, Dalton, Ure, and by many others; and it is therefore well known, that however high may have been the temperature of the steam employed in any engine, the temperature will be instantly reduced to that of atmospheric steam, if allowed to escape and freely expand under atmospheric pressure only, whilst within and passing through a sufficient exhaust pipe. But the behaviour of stame, under the same circumstances, is so different from steam, as to prove that caloric and water must have entered into some further, stricter, and far more peculiar relations in stame, unknown in, and incompatible with, those of steam.

To show this clearly, we have collated, in a table, the different states observed in those different elastic fluids, each freely escaping from working high-pressure engines. The initial density of the steam in boiler was made to differ so greatly, to render the experiment more striking and instructive; for, by this arrangement, there was actually double the incipient caloric in every equal volume of steam of six and a half atmospheres, than in an equal volume of stame of two and a half atmospheres, notwithstanding the steam had been heated out of contact with water to 612°.

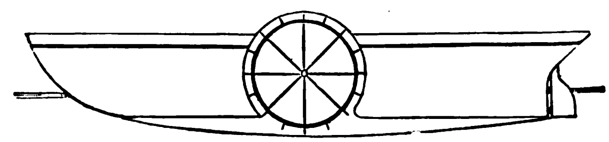
Each experiment lasted half an hour, during which the exhaust steam and stame were respectively conducted from its appropriate working engine, through two feet of exhaust pipe, into the upper part of separate, inverted, large red garden pots, imbedded in and covered with dry sand; the expanded elastic fluids were allowed to escape freely from the lower end of the pots, through a continuation of sufficient exhaust pipes, so that within the pots there could be scarcely more than atmospheric pressure. Within each was introduced the bulb of a thermometer, and also about half a pound of dough to be cooked by the exhaust steam or stame, when the following results were obtained:—

	Density of steam in boilers in atmospheres.	Temperature of steam in boilers.	Temperature of steam in engine.	Temperature within pots.	Different states of dough when taken from pots.	
					Substance.	Surface.
Steam	6.5	321°		216°	Tender.	White glistening.
Stame	2.5	264°	612°	550°	Hard crust.	Charred black.

Brooklyn, New York. JAMES FROST.

NOVEL PADDLE-WHEEL.

In Mr. Braidwood's note of last month, under this title, the illustrative sketch was inadvertently omitted. We now append it—for reference, back to page 282 of our last.



PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

JANUARY 21, 1851.

WILLIAM CUBITT, ESQ., PRESIDENT, IN THE CHAIR.

The discussion on Mr. Digby Wyatt's paper, "On the Construction of the Building for the Exhibition of the Works of Industry of All Nations, in 1851," was continued throughout both these meetings.

On the one side it was contended, that the present building was not in accordance with the conditions published by the Royal Commissioners; that, from its form, the wind would have a most injurious effect on it; and therefore, that instead of testing each girder singly, as had been done, the whole roof should have been subjected to the same ordeal as Turner's roof over the Railway Station at Liverpool, which had been proved by suspending weights at intervals, on the presumed necessity for its bearing a strain of wind equal to fifty pounds per square foot. This test of proof had been suggested by Mr. Locke and Mr. Fox, and therefore it could not be objected to now. The snugs, for receiving the ends of the girders, were considered as being too weak, and liable to fracture. The foundation of concrete under each column was considered insufficient, and not in accordance with the original design, as set forth in the *Illustrated London News*, of July 6th, 1850, where a proper kind of foundation was stated to be provided. The columns of such slender dimensions as eight inches diameter, and varying from one inch and an eighth down to half an inch in thickness, and each composed of seven parts, must be unstable when carried to such heights as sixty-four feet.

The girders of the galleries, when under the action of the multitudes of persons all in one direction, would acquire an undulating motion, which would fracture them.

The glass of the roof being only of the weight of sixteen ounces per square foot, or about one-eighth of an inch in thickness, was quite inadequate to resist hailstorms, or even the weight of a fall of snow, and that great leakage must be expected from this and several other causes. The condensed vapour from the under side of the iron beams would also drop on the goods exhibited, to their serious injury.

The quantity of timber employed, and the system of open flooring, rendered the building peculiarly liable to catch fire; and on these grounds it was asserted to be wanting in the stability and the security requisite for a receptacle for the valuables which would be transmitted for exhibition. It had been stated by the Royal Commissioners, that a building would be provided, free of rent and fireproof: the latter condition was certainly not fulfilled, and if the building remained uninsured, each exhibitor would be under the necessity of providing for the safety of his own goods, and thus be subjected to a greater expense than the ordinary rent of a really fireproof building.

On the other side, it was admitted that, up to the present time, the building was not insured against fire. It was, however, contended, that an examination in detail of all the parts of the structure demonstrated the fallacy of the objections which had been made. Every part had been attentively considered, and had been subjected to careful and minute experiment. The concrete foundation had been tested to the extent of seven tons per square foot without crushing, whilst the greatest weight that could be brought upon each square foot of foundation was only two and a half tons; this was supposing the building to be crowded with visitors, and the roof covered with a depth of two feet of snow.

The columns had also been submitted to similar experiments; their thickness varied from half an inch to one inch and an eighth, according to the duty they had to perform, and the position they occupied in the building. It had been calculated, that the greatest weight which could possibly be brought upon the strongest column was sixty tons, whilst its breaking weight exceeded three hundred tons.

The glass was considered to be sufficiently strong, as its thickness and quality were similar to that used in the large conservatory at Chatsworth, of which not a pane had been broken by any hail-storm that had occurred since its erection twelve years ago. The canvas employed outside would not only temper the rays of the sun, and aid in ventilation, but would also assist in preventing fracture of the glass; and in consequence of the canvas itself being fixed to each ridge in narrow strips, if any portion did catch fire, only that piece would be burned. It was further stated, that on the present design being accepted, an offer had been received for its construction from the person who now most violently attacked the original design and its actual construction.

January 28, 1851.

Arguments, based on calculation, were adduced to show, that though the building was amply sufficient for resisting any vertical pressure to which it might be subjected, it was not so well calculated to resist the horizontal force exerted by the wind, which might be taken as sometimes equalling 25 lbs. per square foot.

The building in Hyde Park was the most extensive example in existence of the "pure rectangular construction," but as it did not possess the strong gable and walls of the Lancashire cotton mills, which were also rectangular structures, composed of columns and girders—the stability of the glass structure must depend entirely on the simple rectangular form, which could only be maintained by the perfect attachment of the girders to the columns. It was contended that the snugs by which this was effected were wanting in strength, and the columns not being attached to, or rooted into the ground, might be supposed to admit of lateral motion. The addition of strong diagonal bracing was therefore recommended, as being necessary to insure that amount of stability requisite in a building intended for the circulation of such multitudes of persons as would attend the Exhibition.

The great amount of light, admitted through a roof entirely composed of glass, was considered objectionable for the display of works of art; and it was contended that a roof partially covered with slates would have been better for general purposes.

Explanations were entered into to show, that the snugs for supporting the girders were amply strong, not only for the general duties they had to perform, but also for resisting any tension, or accidental strains which might be brought on them by the failure of any adjacent parts; and instances were adduced of the occurrence of accidents, during the course of construction, which had proved this position to be correct.

It was contended, that the glass was sufficiently thick, and that, in an extent of roofing of almost forty acres, constructed by one firm during the last twelve years, wherein no glass exceeding the weight of 16 oz. per square foot had been employed, scarcely any breakage had occurred.

It was proposed to use Sir W. Burnett's system of saturation, by a metallic salt, to prevent the accidental burning of the canvas on the roof.

The construction provided for the effects of contraction and expansion, consequent on the changes of temperature.

SOCIETY OF ARTS.

T. M. Gibson, Esq., M.P., Vice-President, in the Chair.

Dec. 11, 1850.

"On the Different Methods of Bleaching Flax, Cotton, Linen, Calico, and other Fibres and Fabrics."—(Continued from page 262.)

I shall now draw your attention to the bleaching of these two fabrics.

The cotton-bleacher has not, like the calico-printer, to ascertain the origin of the cotton wool; for it is indifferent to him to know that Pernambuco cotton takes colours much better than Georgian does; but the quality of his cloth has a most material influence on the nature of the operations and the strength of the solutions to which he has to submit it. Thus, in the case of cloth to be employed for printing, if not perfectly bleached and freed from all resins or gum, it will dye, when put into a madder bath, not only where mordants have been applied, but also on those portions intended to remain white.

Flax goods require no preliminary operations before bleaching, whilst calico requires singeing, *i. e.* the removing of an infinite quantity of small fibres which exist on its surface—an operation which cannot be avoided.

Singeing is effected in three different ways:—First, by passing the cloth over red-hot cylinders. Secondly, by passing it over pipes, from which issue numerous jets of coal gas; above the cloth are corresponding pipes provided with longitudinal openings, into which the flames are drawn through the cloth, by a revolving fan or other means. The third method, recently introduced, is the substitution of coal gas of one less noxious, and giving more intense heat—I mean hydrogen, produced by blowing steam on a bed of red-hot charcoal. After singeing and before they can be printed on, the cotton goods undergo the different operations of bleaching, to remove from the fibre those heterogeneous matters mingled with it by nature, or introduced into it during its manufacture

In the bleaching of cotton fabrics, the operations are simple, rapid, and certain. In that of flax they are complicated, long, and full of risk. This difference is owing to the fact, that in cotton goods the fibre is of a uniform nature, and the colour to be removed is merely retained by resins and gum; whilst linen, besides the small amount of colouring matters which naturally exist in the fibre, and a large proportion added in steeping, contains little pieces of the reed, called *splints*, caused by the impossibility of completely separating the fibres from the woody parts; in fact, all the difficulty of bleaching linen rapidly lies in this unavoidable obstacle: I mean, that when you have bleached it beyond a certain stage, the difficulty is not to get the fibre white, but to preserve it from injury until all the splints are removed; and I have often witnessed, in the bleaching concerns of Ireland, a bleacher compelled to expose his cloth, although quite white, to a series of operations, merely because there remained in it a few splints. Another proof is, that the linen merchants, after having satisfied themselves that the cloth is sound, carefully inspect it to see if it is free from splints. Were it not for this hinderance, there would be little more difficulty in bleaching linen than calico; and I may safely say, that the only difficulty in the way of rapidly changing brown cloth into white linen is their existence.

The fibre, as it exists in the plant, is nearly white, and the colour of ordinary steeped flax, which gives so much trouble to bleach, is owing to the common process of "rating." Of this you will be convinced, on inspecting a sample rated by a new chemical process which I have discovered, and trust ere long to bring to such perfection as will render it commercially useful. The fibre which I separate from the woody parts is so white, that the linen obtained from it will be very easily bleached.

I shall first detail the bleaching of cotton goods. It has arrived at such a degree of perfection and rapidity, that, although usually taking four or five days, cotton may be bleached in twenty-four hours, since the application of bleaching liquors has been thoroughly understood. The operations may be divided under two heads: The first series is for the purpose of removing from the cloth its natural resins, gum, and fatty matter, together with all those substances added to it during its manufacture—such as oily matters, starch, gelatine (from the sizing of the warp), and often metallic oxides, as those of magnesia, copper, or zinc, &c. The operations of the second series are the true bleaching ones, intended to destroy the natural colouring matter, and those which have been added by the spinners and weavers.

The purpose of the operations is shown by the following table of substances added during manufacture:—

Soluble in water	glue, soda or potash, starch, albumen.
Soluble in lime-water	fatty matters, gluten.
Soluble in caustic alkali	fatty matters, linen soap, copper soap.
Soluble in caustic alkali	colouring matter resins.
Soluble in acids	gum resins, resins, oxide of iron, and calcareous and other salts.

A great many modes are adopted for the same end. That I am about to describe is the process most usually followed in Lancashire.

No. of hours.	
3h. 0m.	1. Steeped in water.
0 20	2. Washed in wheels.
8 0	3. Boiled with lime and water.
0 20	4. Washed in wheels.
9 0	5. Boiled in a solution of carbonate of soda (soda ash), 60lbs. for 3,000lbs. of cloth.
0 20	6. Washed in wheels.
0 30	7. Steeped in weak vitriol, sp. gr. 1·025.
2 10	8. Drained 2 hours and slightly washed.
3 0	9. Steeped in a very weak solution of bleaching powder.
26 40	
No. of hours.	
26 40	
0 20	10. Washed.
6 0	11. Boiled in a solution of soda ash (carbonate of soda), 30lbs. for 3,000lbs. of cloth.
0 10	12. Washed.
10 0	13. Steeped in a very weak solution of bleaching powder.
0 10	14. Washed.
0 20	15. Steeped in a solution of vitriol, sp. gr. 1·025.
1 20	16. Drained one hour and well washed.
45 hours.	

This process costs the bleacher about 9d. per 100 lbs. of cloth.

The bleaching price for calico of 32 to 36 inches wide, and 24 yards in length, is 6d.; of 36 to 40 inches wide, and 40 yards long, 10d.

In the case of fine fabric, such as muslin, the boiled lime is done away with. Caustic soda is only employed for stouter goods. The carbonate of soda boil is often replaced by one of soap. The boil with lime is, I think, most important; for lime has great power to change the fatty matters on the cloth into soap; and, being farther decomposed by an acid dip, they are in a condition for being rapidly dissolved by the caustic soda produced by the action of the lime which remains on the cloth.

It is admitted, too, that lime so modifies the colouring matters, that they are more rapidly destroyed by the action of chlorine agents. The application of chlorine as a substitute for the slow action of the air was first discovered by Berthollet in 1785, but was not in use until 1798, when a compound of chlorine and lime was first extensively manufactured under the name of Tennant and Knox's bleaching powder. This valuable agent, which is far superior to chlorine, or a solution of that gas, should be well mixed with water, and all the insoluble parts allowed to settle; for if this is not done, an insoluble compound of chlorine, which forms part of the undissolved powder, attaches itself to the calico, and when it is dipped in acid, is decomposed, and disengages on the spot such an amount of chlorine, that the cloth is instantly burned.

The remarkable discolourating power of chlorine has received two explanations. On one hand, it is considered to be owing to the affinity which it has for hydrogen, by removing a certain proportion of which a colourless substance is left, soluble in water or in other agents. On the other hand, it is said that the chlorine decomposes water and fixes its hydrogen, whilst the liberated oxygen, which was combined with the chlorine, destroys the colouring matter. The strength of the chlorine solution employed depends upon the quality of goods, and the mode of bleaching adopted. In the "slow process," after a dip of a few hours in the bleaching liquors, the pieces are left on stone flags for a long time; while in the "mechanical process," several thousand yards of cloth are attached together, and passed by suitable contrivance successively into the different liquors. Gum thurst is sometimes employed; but I think that its advantages do not compensate for its cost.

During trials which I have made on bleaching, it occurred to me that the following process would be cheaper and more rapid than the one now made use of.

First treat the calico with weak muriatic acid for a few hours at the temperature of 200° Fahr. which will change the starch of the warp into sugar, and by removing it from the cloth, facilitate the action of the alkalies on the fatty matters. To destroy these, I would employ a partly caustic solution of carbonate of soda, then dip in muriatic acid, next in bleaching liquor, and lastly in muriatic acid. I prefer muriatic acid to sulphuric for several reasons. First, because, by not forming the very slightly soluble salt gypsum on the cloth with the lime, it does not prevent the free action of chlorine on its compounds. Secondly, because it more effectually decomposes the bleaching compounds of the bleaching powder.

ROYAL SCOTTISH SOCIETY OF ARTS.

FEBRUARY 24, 1851.

Description of the Lugar Viaduct, erected from the design of John Miller, Esq., C.E., on the Glasgow and South-Western Railway. By John Cameron, Esq., C.E.

The Lugar Viaduct carries the line of the Glasgow and South-Western Railway across the valley of the Lugar, near the village of Old Cumnock, in Ayrshire, and is situated about fifty miles from the terminus at Glasgow. It consists of fourteen semicircular arches, nine of which are fifty feet spans, and five are 30 feet spans; three 30 feet spans terminate the viaduct at the north end, and two at the south end. The large arches are separated from the small ones by abutments, 16 feet 6 inches thick. The greatest height of the viaduct is at the water pier, where it is 161 feet 6 inches from the foundations to the top of the parapet. The average height, including the parapet, is 94 feet 6 inches. The total length is 752 feet. The viaduct is built level throughout. The ground on which the viaduct is built consists of beds of limestone and coal; the coal being mostly worked out. This gave rise to some difficulty in the founding of some of the piers. Shafts were sunk to find the exact position and condition in which they were. It was found that the waste was about 2 feet thick, and as there existed two or three beds of limestone between the coal workings and the surface of the ground, it was decided that the coal workings should be filled up. The coal workings were cleared of all refuse and soft material, and built up with dry stone-packing for a considerable distance under the piers; and the complete success of the operation was proved by the absence of all appearance of sinking in of any of those piers which were founded in this manner. The piers are all what are termed hollow piers: those of the large arches are 7 feet thick at the springing, and those of the small arches are 5 feet. The large piers are bonded across horizontally every 15 feet in height, with a view of counteracting any tendency which such tall and slender piers might have to twist—at the same time acting as intermediate covers to the piers during their execution. The water pier is built up solid for 11 feet above its foundations. The abutments of the small arches, which have also to receive the pressure of the embankments at each end of the viaduct, are 23 feet thick at the springing of the arches, and are hollow in the same manner as the piers. All the abutments and piers have a batter of 1 inch in 5 feet on the faces. The insides of the piers have a batter of 1 inch in 10 feet. The voussoirs of the large arches are of droved ashlar, 2 feet deep, no stone being more than 3 feet 6 inches, or less than 2 feet 3 inches long. The small arches are 1 foot 6 inches deep in the voussoirs of the same description as those in the large arches. The solid spandrils of the large arches are carried up 15 feet above the springing. The outer spandrils are 3 feet, and the inner spandrils are each 2 feet thick. The viaduct is puddled throughout with a layer of clay puddle, 9 inches thick; and above the puddle a layer of sand is laid 9 inches thick. The piers and abutments were built to the height of 20 feet above the ground with derrick cranes; above that level a service road was used. During the whole time that the work was executing, there was only one fatal accident. The work does the utmost credit to the contractor, Mr. James M'Naughton. This noble specimen of railway architecture contains the immense quantity of 500,000 cubic feet of masonry, the weight of which is about 33,500 tons. The total cost has been about £30,000; the expense of the centring alone being £4,500.

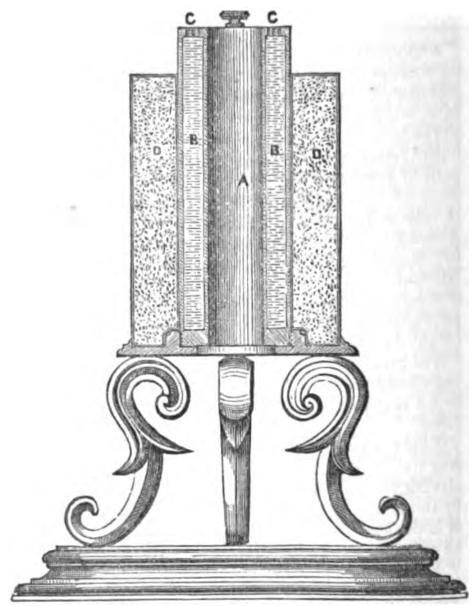
MONTHLY NOTES.

POPULAR NOTIONS OF PHILOSOPHERS.—People who have no personal acquaintance with philosophers believe them to be a grim and unamusable race. We remember once witnessing the first introduction of a sound-headed country sportsman and an ingenious though unlearned sailor, neither of whom had ever sat side by side with professional men of science before, into a merry dinner party of which all the other human elements were scientific. They were uneasy and out of their element, until, to the surprise of each, one found a skilled and successful angler in the naturalist beside him, and the other a practical and experienced boatman in the geologist at his elbow. We would undertake, without travelling far, to furnish philosophers of various scientific callings who could ride a race, hunt a fox, shoot a snipe, cast a fly, pull an oar, sail a boat, dance a polka, sing a song, or mix a bowl against any man with unexercised brains, or even with none at all, in the united kingdom.—*Literary Gazette.*

SPEED OF MODERN STEAMERS—THE "BANSHEE."—At a recent trial of the celebrated Government steamer, the "Banshee," now commanded by Lieut. Hosken, she attained a speed 16·077 miles through the water. It will be remembered that this vessel is built of mahogany, from the designs of Mr. Lang of Chatham, by Mr. Thompson of Rotherhithe, with Penn's oscillating engines.

PRINTING BY HYDROSTATIC PRESSURE.—Our earlier pages have frequently canvassed the presumed advantages of the employment of the hydrostatic pressure, derived from the ordinary waterworks of towns. In America the system has been actually adopted, and we find that, in Boston, the printing-press of a daily paper is so worked in this way. Through a two-inch lead pipe, a stream of Cochituate water is introduced into a meter, which only occupies 24 square inches. The fall of water between the Boston reservoir and this meter is about a hundred feet. This two-inch stream will discharge eighty gallons of water each minute, and in passing through the meter will give a motive power equal to what is called three-horse power. This is more than sufficient for driving the press. It is less hazardous than a steam-engine, requires no attention, and is always in readiness.

SCOULLER'S FOG SIGNAL FOR STEAMERS.—Mr. James Scouller of Glasgow, the inventor of the extraordinary "Self-heating shot for war purposes,"* has contrived a very valuable signal for ships' use during dense fogs. Our engraving exhibits a vertical section of an example of this signal, which has been prepared for the Great Exhibition. The light apparatus rests upon a tripod stand, a double tube, A, being screwed on to the top of the circular plate carried by the ornamental standards. This tube is open throughout its centre, A, the annular space, B B, between the two tubes being closed in at both ends, the upper end being shut in by a perforated cover, C C, screwed on, forming an argand burner. Outside this tubular chamber is placed a species of tubular cartridge, or hollow case of paper, filled with some powerful combustible, as represented by the section at D D. To charge the signal for use, the annular chamber, B B, is filled with naphtha, or other spirit of similar character, and the paper chamber of combustible matter, D D, being slipped over the naphtha reservoir, the combustible is set on fire. A great heat is thus brought to bear upon the naphtha chamber, and the spirit is volatilized, rushing with a fierce flame through the argand burner at C C, to a height of twenty or thirty feet. This long string of flame gives an intense white light, sufficient to penetrate to some distance through the densest fog. The numerous awful accidents constantly arising from the occurrence of dense fogs, ought to make us turn our attention to all possible means of avoiding them. Mr. Scouller's plan deserves an extended trial.



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CARRETT'S IMPROVED ENGINEER'S RULE.—Mr. W. E. Carrett, of Leeds, whose improved steam-pump and valve-seat have been recently noticed in the *Practical Mechanic's Journal*, has submitted to us a very elaborate improvement upon the common rule. The nature of the instrument prevents our giving a pictorial illustration of it, but we shall probably succeed in explaining its more material points without such assistance. The rule presents, in one instrument, a complete set of tables and data for reference, the principal divisions of English and French measure, and the general scales required either for the preparation of drawings, or the actual construction of such articles as those drawings shall represent.

* See *P. M. Journal*, p. 70, vol. ii.

Upon opening the instrument to its full length, one side presents the division of inches into 8ths, 16ths, and 12ths; and upon the edge are 10ths of an inch, and 10ths of a foot. Annexed are the ordinary scales—3 inches, $1\frac{1}{2}$ inch, $\frac{1}{2}$ and 1 inch, used in drawing, arranged to count up continuously the entire length of the rule, and so situated with regard to the edge, that they can be read off either with or without the use of compasses. On the other side are smaller scales, $\frac{3}{4}$, $\frac{3}{8}$, $\frac{1}{4}$, and $\frac{1}{8}$ inch, similarly placed for convenience of application. The facilities afforded by this modification are very great, rendering the "engineer with his rule" quite independent of all other instruments, whether he require the sizes of machinery in full, or from the drawings of such machinery represented to a given scale. Further, the rule is designed in a measure to assist the memory, and dispense with the use of a note-book, by thus furnishing at a glance many of the chief data of computation required by the engineer. These tables show—the extreme cohesion per square inch in a fair quality of the different metals, and the weight in lbs. of a cubic inch of each; the common multiple for cubic inches of wrought and cast-iron, to ascertain the weight in lbs.; the weight in lbs. of a square foot of boiler plate of different thicknesses, from an inch down to $\frac{1}{16}$th; the weight per cubic foot of different woods, fuel, and building materials; the comparison of weight in different compositions of earth to a ton; the weight, measure, and volume of water; linear measure, from a link up to a mile; square measure, from a chain up to a mile; a comparison of the Birmingham wire-guage to 8ths, 16ths, and 32ds of an inch; fractional and decimal equivalents of parts of an inch; the temperature of boiling water, and corresponding pressures above that of the atmosphere; and the values of expansion to be derived from one unit of steam, corresponding with different increase of volume—the expression of cylinder with "full steam" being 1·0. Adjoining these is a scale of centimeters, with a comparative table of the different divisions of French meters to English inches, and a scale of chords for ascertaining the magnitude of angles. The guage points of the ordinary engineer's rule are wholly omitted, as being foreign to the design of the invention; but for cases where it is found applicable, the slide and its divisions are retained. Two steady-pins of steel, between the inner edges of the rule, can be used as callipers, the diameter being measured across their points with the inches and eighths on back of slide. The rule is already in pretty extensive use. It is made by Messrs. Elliot & Son, of 56 Strand.

Reclamation of Waste Land.—Amongst the contributions to the Great Exhibition, are two plans of the Corwar estate in Ayrshire, the property of Rigby Wason, Esq., showing what has been done in the way of agricultural improvement since 1840. The first picture presents the estate as it appeared in 1840—raw, barren, and unproductive. The second exhibits it as it now is, and details the splendid results of judiciously applied capital. The reputation of the estate as an example of reclamation, will make these comparative illustrations most interesting to the agricultural viewers of the Exhibition.

Steam Power in France.—There exist in France 5,607 manufactories of various denominations, in which steam machinery is employed. This machinery is worked by means of boilers, the number of which is 9,288, and of which 8,776 were made in French establishments. These boilers represent a force of 65,120 horses' power, calculating the horse power as 75 kilogrammes (180 lbs.), raised one metre (1 yard) per second. These boilers represent the force that would be produced by 195,361 draught horses and 1,367,530 labourers. The steam horse power is equal in effect to about four draught horses and 21 labourers. The number of boilers employed in the preceding year was only 8,023, and only 4,033 establishments existed in which steam power was used. The length of railway now open for traffic is 2,171 kilogrammes (1,300 miles), on which are employed 725 locomotives. The number of steam trading vessels is 279. Their tonnage amounts to 40,098 tons. They are propelled by 502 engines, constituting a total power of 22,893 horses. The merchandise transported by these vessels amounted to 730,948 tons.

Infringement of a Registered Design.—Hodges v. Driver.—The plaintiff in this action had registered a design for the manufacture of a hollow ventilating brick, and the present action was brought upon an agreement into which the plaintiff had entered for the sale of the use thereof to the defendant. The defendant in substance pleaded that the registered design was not valid; and contended that the invention was not one which could be protected under the Registration of Designs Act, but ought to have been protected by a patent. At the trial, which took place before Mr. Justice Patteson at the Berkshire assizes, the plaintiff obtained a verdict; but subsequently a rule *nisi* had been granted for a new trial, upon the ground that the invention could not be protected under the Designs Act, but ought to have been made the subject of a patent. Mr. Alexander, Q.C., and Mr. Seife, now showed cause against the rule, and contended that in this case the "form and configuration" of the bricks were different from the form and configuration of bricks which had formerly been in use. The bricks were hollow, and were so formed as to allow the free passage of air, so that a house built with such bricks could be ventilated. This was a new form and configuration of an old material, and was therefore expressly within the terms of the Registration Act. Mr. Gray supported the rule, and contended that the bricks in question could not be considered as within the Registration Act, for that statute was expressly confined to cases where there was a novelty in the "form and configuration" of the article. The bricks had the same external form as those previously made, and they could not be said to have any novelty in the "form or configuration." There was no change of form, but only an application of the principle of having hollow bodies in cases where solid bodies had been used before. The invention was, therefore, the proper subject of a patent, and the plaintiff must protect his right in the ordinary way by taking out a patent. The registration was but an attempt to evade the performance of that duty. The registration was therefore void, and the defendant's plea was well supported. The court decided that the use of a hollow instead of a solid form of the brick, and of such a configuration as to allow of ventilation, brought the case within the Registration Act. Though the plaintiff might have protected his invention by a patent, he was not precluded from contenting himself with the shorter protection of the Registration Act. The rule for a new trial must, therefore, be discharged.

The Electric Telegraph Company—Judgment on Application for Extension of their first Patent.—We give below Lord Langdale's judgment in this important case, *in extenso*:—This is an application for the prolongation of a patent right, which was granted, in 1837, to Mr. Cooke and Mr. Wheatstone. In the opening of the case by Sir Frederick Thesiger, there were two points raised, to which in particular our attention was directed. The first was, the value and importance of the undertaking, and its utility to the public; and the second was, what remuneration had been obtained by the original patentees for the advantages which had been derived by the Company from it. As to the first, it is not necessary to enter into any statement whatever; and the only question which remains for us to consider is, whether, upon the evidence which has been produced, there has been such a deficiency of remuneration to the discoverer or the inventor, as to make it proper, and for the interest of the public, to grant the prolongation which is required. Now, with regard to that, it appears that the inventors were Messrs. Cooke and Wheatstone. The patent was granted to them in the year 1837; and from the year 1837 to the year 1845 they had principally, I believe, by the employment of capital by Mr. Cooke, given very extensive information of the advantages of the invention, and the facility with which it might be employed to the purposes for which it was brought forward. Mr. Cooke has stated that, in the year 1845, the time when the connection of himself and Mr. Wheatstone commenced with the Electric Telegraph Company (the now petitioners), it had been sufficiently shown to all persons who were attending to such matters, that the invention was capable of being applied very extensively to the purposes for which it was invented; and the Electric Telegraph Company were desirous of working the telegraph, and carrying on all the business connected with it. They well considered the value of the invention; and upon that consideration it appears that they gave to Mr. Cooke, in money or in value, no less a sum than £141,000 for this invention, which, by the mere statement of what was then done, appears to have been of great value indeed. Mr. Wheatstone has received from Mr. Cooke, in respect of his share, not only the sum of £30,000, but also a sum of £1,400 or £1,500, which has been paid to him in respect of what is called a royalty or rent for the use of it. That is what Mr. Wheatstone has received. Mr. Cooke had expended money in bringing this invention to maturity, and the money which he had expended had exceeded his receipts to the amount of £4,424. Now, if the sum of £30,000 was paid to Mr. Wheatstone, and the sum of £4,424 was the expense of payments, which are contained in the account of receipts and payments, the royalty paid to Mr. Wheatstone not being included in that, then Mr. Cooke has received £106,681 clear. Well then, there were these sums paid to the inventors. The invention was sold by the inventors with a full knowledge of their own of the capability of its being applied to the public use; with a full knowledge, also, of the persons who had become the purchasers—and, I am happy to say, as a commercial speculation, it has answered their full expectations; and notwithstanding, indeed, very large payments were made, they are able to realize a remunerative profit. They have accordingly carried on business in working the telegraph from the year 1846, when the bargain was completed, down to the present time. Accounts have been rendered to us with the view of its being shown to us, from those accounts, that since that time it has not been a profitable concern. Now, upon the investigation and examination of those accounts, it does not appear to us that such is the case; on the contrary, we think that there is sufficient reason to believe that, in addition to that profit which was obtained by the inventors themselves before the bargain was made, or at a time when the bargain was made to the Company, there has been subsequently a profit to a considerable amount made by them; and, therefore, it seems to us, that there is not such a defect of remuneration to the inventor as to make it proper to extend the monopoly by the power of her Majesty, acting under the advice of this committee. We do not say that it would be right to take into consideration the mere commercial transaction of a Company of this kind, if it had turned out to be unprofitable; for, by this patent right, they buy it for a commercial speculation, not at all with a view of profiting or rewarding the inventor, though, when they are seeking to remunerate themselves, they accidentally give a profit to the inventor. This is a Company which, with a knowledge of the value of the invention, of its capability of being reduced to practical use, to any extent to which capital might be employed, think fit to engage that capital in carrying on their trade by the use of this particular invention. Now, if that had been clearly made out to be a losing concern, it would perhaps have been matter of some consideration; but we are of opinion that it has not been made out to be a losing concern, but that, on the contrary, it appears to be a profitable concern. Although, instead of their paying dividends, they carry them to the capital account to relieve the shareholders, that does not make it less a profitable concern. We are, therefore, on the whole, of opinion, on consideration of this case, that we cannot comply with the prayer of this petition.

Green Paper and White Ink.—Mr. Harvey, the Postmaster of Weymouth, proposes that all writing and printing should be effected with white ink, on a dark green ground. He says, "It is admitted that travelling on the turnpike road is subject to a glare of light, and proceeding off it, to an adjacent green part, the eye becomes greatly relieved. By the same rule, a green newspaper printed with white ink, would be preferred to a white one printed with black ink." The practical application of the colour of Nature's livery, has been often speculated upon—but no one has been bold enough to try this branch of it. If the notion becomes popular, our chemists must bestir themselves to produce a good dark green paper, and a cheap and serviceable white ink.

REES' PATENT FUEL.—Among the patents granted in January last, is one to Mr. W. Rees, of Pembrey, for "Improvements in the Preparation of Fuel." This patent is likely to prove of great value to districts where coal is abundant, the invention being a simple and novel mode of solidifying small coal, *without the aid of extraneous matter of any kind*, the elementary properties of the coal supplying the agency of cohesion. The leading advantages conferred are—that by the absence of pitch or tar in its manufacture, the disagreeable effluvia and smoke emitted by other processes are avoided; and also, that in its transit through warm climates during long voyages, there is no risk of its "running" or melting from the influence of heat or stowage;—that if made from coals highly charged with sulphur and pyrites, it is not liable to explosion from spontaneous combustion;—that it is of greater specific gravity, and consequently more durable, than the large coal of the same seams, evolving less smoke, and being more portable. The process is simple and inexpensive, and has this peculiarity—that, by varying the constituents, it is applicable to all purposes, from the kitchen to the smelting of metals or the steam-engine; and by its use, the disagreeable volume of black smoke, invariably resulting from the use of artificial fuel composed of pitch or tar, is avoided. When the specification is enrolled, we shall furnish actual details of the process of manufacture, and the results of practical trials of the fuel.

THE ELECTRIC TELEGRAPH IN FRANCE.—The Government has just made known the different stations where offices for private correspondence are to be established. The Northern line will have six offices:—Amiens, Arras, Valenciennes, Lille, Calais, and Dunkirk. The Centre line six:—Orleans, Tours, Angers, Bourges, Nevers, and Châteauroux. The Havre line will have two, and that of Strasburg one at Chalons. None are yet fixed for the Lyons line, but the Government will be prepared to organize them on the two last lines as soon as the electric wires have been placed. The committee recommends that they shall be distributed in the same manner as those on the Northern line, promising the necessary credits for it. The following is the tariff of charges as decided on by the Government:—"For a despatch of twenty words, including the name of the person sending and that of the person to whom it is addressed:—

		F.	C.
"From Paris to	Amiens,	4	80
"	Arras,	5	64
"	Valenciennes,	6	36
"	Lille,	6	36
"	Calais,	7	56
"	Dunkirk,	7	32
"	Orleans,	4	56
"	Tours,	5	88
"	Angers,	7	60
"	Bourges,	5	88
"	Nevers,	6	72
"	Châteauroux,	6	24
"	Châlons-sur-Marne,	5	10
"	Rouen,	4	68
"	Havre,	5	76"

In order to calculate the charge of a despatch of the above number of words from one town to another on the same line, it will be only necessary to calculate the difference in the charge from Paris to the two places, and add 3f. Thus, the charge from Amiens to Arras will be 3f. 84c., and from Arras to Lille, 3f. 72c. For despatches of more than twenty words a fourth is to be added for every ten words, so that the above tariff will be double for sixty words. Our readers who know the distances given in this table, will be able at a glance to compare English with foreign telegraphic charges.

ENGLISH PATENTS.

Sealed from 12th February to 20th March, 1851.

Edwin Ullmer, of the firm of Edwin and William Ullmer, Fetter-lane, London, printing-press makers,—"Certain improvements in printing-presses."—February 12th.

Charles William Tupper, Oxford-terrace, Middlesex, gentleman, and Alphonse Rene le Mere de Normandy, Dalston, in the same county, gentleman,—"Improvements in the manufacture of iron coated with other metal, commonly called galvanized iron."—12th.

Charles Cowper, 20 Southampton-buildings, Chancery-lane,—"Improvements in moulds for electro-metallurgy."—17th.

Henry Francois Marie de Pons, 24 Boulevart Poissonnière, Paris, France, gentleman, —"Improvements in constructing roads and ways, and pavements of streets, and the ballast of railways."—17th.

Gustav Adolph Buchholz, Norfolk-street, Strand, Middlesex, civil engineer,—"Improvements in motive power and in propulsion."—17th.

David Ferdinand Masirata, Golden-square, Regent-street, Middlesex, gentleman,—"A new mechanical system with compressed air adapted to obtain a new moving power."—18th.

Thomas Dickason Rotch, Furnival's-inn, gentleman,—"Improvements in centrifugal apparatus for separating fluid from other matters."—18th.

William Beadon, jun., Taunton, Somerset, gentleman,—"Improvements applicable to the roofing of houses, buildings, and other structures."—18th.

Hugh Lee Pattinson, Scots-house, Gateshead, manufacturing chemist,—"Improvements in the manufacture of Pattinson's oxichloride of lead."—18th.

Henry Richardson, Aber Houran Balor, North Wales, Esq.,—"Certain improvements in life-boats."—22d.

William Stones, Queenhithe, London, stationer,—"Improvements in the manufacture of safety-paper for bankers' cheques, bills of exchange, and other like purposes."—24th.

Edward Lloyd, Dee Valley, near Corwen, Merionethshire, North Wales, engineer,—"Certain improvements in steam-engines, which improvements are in part or on the whole applicable to other motive engines."—24th.

Peter Wood, of the firm of Bury & Co., dyers, finishers, and calenderers, Salford, Lancaster,—"Improvements in printing, staining, figuring, and ornamenting woven and textile fabrics, wood, leather, or any other material substance or composition, and in machinery and apparatus employed therein."—24th.

John Hinks, Birmingham, manufacturer, and James Vero, Burbage, Leicester, manufacturer,—"Certain improvements in the manufacture of hats, caps, bonnets, and other coverings for the head."—24th.

Gabriel Didier Fevre, Paris, France, gentleman,—"Certain improvements in apparatus for manufacturing and containing soda-water, and other gaseous liquids, and also in preserving other substances from evaporation."—24th.

Thomas Wicksteed, Old Ford, Middlesex, civil engineer,—"Improvements in the manufacture of manure and in machinery to be used therein."—24th.

Robert Adams, King William-street, London, gunmaker,—"Improvements in rifles and other fire-arms."—23d.

Francis Clark Monatis, Earlston, Berwick, builder,—"An improved hydraulic syphon." —23d.

Isaac Lothian Bell, Washington Chemical Works, near Newcastle-upon-Tyne, chemical manufacturer,—"Improvements in the manufacture of sulphuric acid."—23d.

Henry Dircks, Moorgate-street, London, engineer,—"Improvements in the manufacture of gas, in gas-burners, and in apparatus for heating by gas."—23d.

Charles Frederick Bielfield, Wellington-street North, Strand, papier-maché manufacturer,—"Improvements in the manufacture of sheets of papier-maché, or substances in the nature thereof."—24th.

Samuel Cunliffe Lister, Manningham, near Bradford, York,—"Improvements in preparing and combing wool and other fibrous materials."—24th.

Robert Hawthorn and William Hawthorn, Newcastle-upon-Tyne, engineers and partners,—"Improvements in locomotive engines, parts of which are applicable to other steam-engines."—24th.

Amedée François Remond, Birmingham, gentleman,—"Improvements in the manufacture of metallic tubes or pipes, and the machinery or apparatus connected therewith, which improvements are applicable to other like purposes."—26th.

Thomas Ellis the elder, Tredegar Iron Works, Monmouth, engineer,—"Certain improvements in machinery or apparatus to be employed in the manufacture of blooms or piles for railway, and other bars or plates of iron."—27th.

William Millward, Birmingham, plater,—"Certain improvements in electro-magnetic and magneto-electric apparatus."—28th.

Charles Felton Kirkman, Argyle-street, gentleman,—"Certain improvements in machinery for spinning and twisting cotton, wool, or other fibrous substances."—28th.

Henry Willis, Manchester-street, Middlesex, organ-builder,—"Improvements in the construction of organs."—28th.

James Leach, Littleborough, Lancaster, cotton-spinner,—"Certain improvements in machinery or apparatus for carding, spinning, doubling, and twisting cotton and other fibrous substances."—28th.

William Edward Newton, Chancery-lane, Middlesex, civil engineer,—"Improvements in portable bedsteads, and in sacking bottoms."—(Being a communication.)—28th.

William Milner, Liverpool, Lancaster, safety-box manufacturer,—"Certain improvements in boxes, safes, or other depositories, for the protection of papers or other materials from fire."—March 3d.

Alfred Vincent Newton, Chancery-lane, Middlesex, mechanical draughtsman,—"Improvements in the preparation of materials for the production of a composition or compositions applicable to the manufacture of buttons, knife and razor handles, in inkstands door-knobs, and other articles, where hardness, strength, and durability are required."—(Being a communication.)—4th.

Peter Armand Lecomte de Fontainemoreau, Smith-street, Finsbury, patent agent,—"Improvements in compressing air and gases for the purpose of obtaining motive power." —(Being a communication.)—10th.

Victor Hyacinthe Libert Guillouet, Condé Sin Noirot Calvados, France, chemist,—"Certain processes for increasing on manufactured fabrics the several shades of indigo." —10th.

Elijah Galloway, Southampton-buildings, Chancery-lane, Middlesex, civil engineer,—"Improvements in steam-engines."—10th.

Henry Alfred Jowett, Sawley, near Derby, engineer,—"Improvements in railway breaks and carriages."—10th.

George Robins Booth, Portland-place, Wandsworth-road, Surrey,—"Improvements in generating and applying heat."—10th.

James Murray, Canterbury, Kent, barrack-master and captain,—"Improvements in saddlery and harness."—10th.

Jean Baptiste Alphonse Brunet, Paris, France, gentleman,—"Improvements in the manufacture of coverings for roofs, walls, partitions, furniture, and other similar articles, and in boxes, tubes, and other hollow articles, and in the preparation or manufacture of materials to be employed for such purposes, and also in machinery to be employed in such or similar manufactures."—(Being a communication.)—10th.

Thomas Horn, Stanhope-street, May Fair, upholder and decorator,—"Machinery or apparatus for cleansing carpets, matting, and similar fabrics."—10th.

George Roberts, Selkirk, manufacturer,—"An improved manufacture of certain yarns of linen, wool, silk, cotton, or other fibrous substances."—10th.

William Galloway and John Galloway, Manchester, engineers,—"Improvements in steam-engines and boilers."—10th.

Jesse Ross, Victoria-terrace, Keighley, York, gentleman,—"Certain improvements in machinery and other apparatus for combing wool, and other suitable fibrous substances, and in applying or working the same."—13th.

Thomas Dawson, Milton-street, Euston-square, machinist,—"An improved method of constructing umbrellas and parasols."—13th.

George Little, New Peckham, electro-telegraphic engineer,—"Improvements in electro telegraph, and in various apparatus to be used in connection therewith, part of which improvements are also applicable to other similar purposes."—14th.

Herbert Taylor, Cross-street, Finsbury, Middlesex, merchant,—"Certain improvements in the manufacture of carbonates and oxides of barytes, and strontia, sulphur, or sulphuric acid, from the sulphates of barytes and strontia, and for consequent improvements in the manufacture of carbonates and oxides of soda and potasia."—15th.

Richard Archibald Brooman, of the firm of J. C. Robertson & Co., Fleet-street, London, patent agents,—"An improved method of manufacturing screws."—15th.

Herbert Minton, Hart's-hill, Stafford, gentleman, and Augustus John Hoffstaedt, Bridge-street, Blackfriars, London, gentleman,—"Improvements in the manufacture of faces or dials for clocks, watches, barometers, gas-meters, and mariners' compasses, or other articles requiring such faces or dials."—(Partly a communication.)—17th.

Alexander Robertson, Holloway, Middlesex, engineer, and James Glover, of the same place, roller,—"Improvements in the rolling and laminating of metals, and in the manufacture of metallic cases and coverings."—20th.

James Hart, Seymour-place, Middlesex,—"Improvements in the manufacture of bricks, tiles, and other articles made from plastic materials, and in the means of making parts of the machinery used therein."—17th.

Henry Bessemer, Baxter-house, Old St. Pancras-road, Middlesex, engineer,—"Improvements in the manufacture and refining of sugar, and in machinery or apparatus used in producing a vacuum in such manufacture, and which last improvements are also otherwise applicable for exhausting and forcing fluids."—20th.

SCOTCH PATENTS.

Sealed from 23d January, to 22d March, 1851.

James Slater and John Nuttall Slater, Dunscar, Bolton-le-Moors, Lancaster, bleachers, —"Certain improvements in machinery or apparatus for the stretching and opening textile or woven fabrics."—January 23d.

James Hamilton, London, engineer,—"Improvements in machinery for sawing, boring, and shaping wood."—23d.

Julian Bernard, Green-street, Grosvenor-square, Middlesex, gentleman,—"Improvements in the manufacture or production of boots and shoes, and other articles made of leather, dressed skins, or other materials, and in the materials and machinery or apparatus to be employed therein."—(Communication.)—24th.

Richard Archibald Brooman, of the firm of Messrs. J. C. Robertson & Co., 166 Fleet-street, London, patent agents,—"Improvements in steam machinery, and apparatus connected therewith."—(Communication.)—24th.

Richard Archibald Brooman, of the firm of Messrs. J. C. Robertson & Co., 166 Fleet-street, London, patent agents,—"Improvement or improvements in abdominal supporters."—(Communication.)—24th.

Charles de Bergue, Arthur-street West, London, engineer,—"Improvements in the construction of the permanent ways of railways."—27th.

Samuel Clift, Bradford, near Manchester, manufacturing chemist,—"Improvements in the manufacture of muriatic acid, soda, potash, glass, and of chlorine."—27th.

William Beckett Johnston, Manchester, Lancaster, manager for Messrs. Ormerod & Son, engineers,—"Certain improvements in steam-engines, and in apparatus for generating steam, such improvements in engines being wholly or in part applicable, whether other vapours or gases are used as the motive power."—29th.

Samuel Morand, Manchester,—"Improvements in apparatus used when stretching and drying fabrics."—29th.

Edward David Ashe, Brompton, Middlesex, lieutenant in her Majesty's Royal Navy,—"A new and improved nautical instrument or instruments, applicable, especially amongst other purposes, to those of great circle sailing."—29th.

William M'Gavin, Glasgow, Lanark, miller,—"Certain improvements in steam-boilers, and furnaces and fire-places, and in the prevention of smoke."—29th.

Joshua Horton, Ætna Works, Smethwick, Stafford, steam-engine boiler and gasholder manufacturer,—"Improvements in the construction of gasholders."—30th.

Peter Fairbairn, Leeds, York, machinist, and John Hetherington, Manchester, Lancaster, machinist,—"Certain improvements in mouldings for casting pipes, railings, gates, agricultural implements, and other metal articles, and also in preparing patterns or models for the same."—31st.

John Stopporton, Isle of Man, engineer,—"Certain improvements in propelling vessels, parts of which improvements are applicable to steam-engines and pumps."—31st.

Frederick Watson, Hulme, near Manchester, Lancaster, gentleman,—"Improvements in sails, rigging, and ships' fittings, and in machinery and apparatus employed therein."—February 3d.

Nathaniel Jones Amies, Manchester, Lancaster, manufacturer,—"Certain improvements in the manufacture of braid, and in the machinery or apparatus connected therewith."—3d.

Benjamin Rotch, Lowlands, Middlesex, Esq.,—"A factitious saltpetre, and a mode by which factitious saltpetre may be obtained for commercial purposes."—3d.

James Webster, Leicester, engineer,—"Improvements in the construction and means of applying carriage and certain other springs."—5th.

Henry Bessemer, Baxter-house, Middlesex, civil engineer,—"Certain improvements in the sugar-cane process."—6th.

Selim Richard St. Clair Massiah, Alderman-walk, New Broad-street, London,—"Certain improvements in the manufacture of artificial marble and stone."—7th.

Joseph Shaw, Paddock, near Huddersfield, York, cloth finisher,—"Certain improvements in constructing and working certain parts of railways."—7th.

Francis Clark Monatis, Earlston, Berwick, Scotland, builder,—"An improved hydraulic syphon."—7th.

Richard Stuart Norris, Warrington, Lancaster, civil engineer,—"Certain improvements in the construction of the permanent way of railways, bridges, locks, and other erections, wholly or in part constructed of metal; also, improvements in breaks for railway carriages."—10th.

William Weild, Manchester, Lancaster, engineer,—"Improvements in machinery for turning and burnishing."—10th.

William Edward Newton, Office for Patents, 66 Chancery-lane, Middlesex, civil engineer,—"Improvements in machinery or apparatus for producing ice, and for general refrigeratory purposes."—(Communication.)—11th.

Ewald Riepe, Finsbury-square, London, merchant,—"Improvements in refining steel."—(Communication.)—12th.

Peter Claussen, Cranbourne-street, Middlesex, gentleman,—"Certain improvements in bleaching, in the preparation of materials for spinning and felting, and in yarns and felts, and in the machinery employed therein, part of which improvements have been communicated to him by a foreigner residing abroad."—12th.

Alfred Vincent Newton, Office for Patents, 66 Chancery-lane, Middlesex, mechanical draughtsman,—"Improvements in manufacturing looped or other woven fabrics."—(Communication.)—14th.

Charles Gotthalf Kind, Paris, France, engineer, and Charles Alexis de Wendel, ironmaster, also of Paris, France,—"Improvements in the process, and instruments to be used for boring the earth, and sinking shafts of any given diameter, for mining and other purposes, and in the means of lining such shafts."—14th.

James Thomson Wilson, Stratford-le-Bow, Middlesex, chemist,—"Improvements in the manufacture of alum, and in obtaining ammonia."—14th.

David Ferdinand Masnata, Golden-square, Regent's-park, Middlesex, gentleman,—"Improvements in obtaining motive power when compressed air is used."—17th.

William Burgess, Newgate-street, London, gutta percha dealer,—"Improvements in machines for cutting turnips, and other substances."—17th.

Thomas Wickstead, Old Ford, Middlesex, civil engineer,—"Improvements in the manufacture of manure."—19th.

Bennet Woodcroft, Furnival's-inn, London,—"Improvements in machinery for propelling vessels."—21st.

Adolphus Oliver Harris, High Holborn, Middlesex, philosophical instrument maker,—"Improvements in barometers."—(Communication.)—26th Feb.

Joseph Crossley, Halifax, carpet manufacturer, George Collier, of the same place, mechanic, and James Hudson, Littleborough, printer,—"Improvements in printing yarns for, and in weaving carpets and other fabrics."—3d March.

George Smith, Manchester, Lancaster, engineer,—"Certain improvements in steam engines, and also improvements in feeding or supplying the boilers of same, part or parts of which improvements are also applicable to other similar purposes."—4th.

John Hetherington, Manchester, Lancaster, machinist,—"Improvements in machinery for preparing, spinning, and manufacturing fibrous substances."—4th.

Alfred Cooper, Rumsay, Herts,—"Improvements in steam and other power engines, and in the application thereof to motive purposes; also in the method of, and machinery for, arresting or checking the progress of locomotive engines, and other carriages."—5th.

Henry Richardson, Aber Hernant, Balda, North Wales, Esq.,—"Certain improvements in life boats."—7th.

William Stones, Queen's Hythe, London, stationer,—"Improvements in the manufacture of safety paper for banker's cheques, bills of exchange, and other like purposes."—7th.

Joseph Baldwin, and George Collier, mechanics, and Joseph Crossley, all of Halifax,—"Improvements in the manufacture of carpets and other fabrics."—12th.

George Roberts, Selkirk, Scotland, manufacturer,—"An improved manufacture of certain yarns, of linen, wool, silk, cotton, and other fibrous substances."—13th.

Samuel Brisbane, Manchester, Lancaster, pattern maker,—"Certain improvements in looms for weaving."—14th.

George Guthrie, Appleby, chamberlain to the Right Hon. the Earl of Stair, residing at Rephad, by Stranraer, Wigton,—"Improvements in digging, tilling, and working land."—14th.

Richard Archibald Brooman, of the firm of J. C. Robertson & Co., 166 Fleet Street, London, patent agent,—"Improvements in purifying water, and preparing it for engineering, manufacturing, and domestic purposes."—(Communication.)—17th.

Edward Lloyd, Dee Valley, Merioneth, North Wales, engineer,—"Certain improvements in steam engines, which improvements are in part, or on the whole, applicable to other motive power."—17th.

William Eccles, Walton-le-Dale, Lancaster, cotton spinner,—"Certain improvements in looms for weaving."—17th.

Herbert Taylor, 46 Cross-street, Finsbury, Middlesex, merchant,—"Certain improvements in the manufacture of carbonates and oxides of barytes and strontia, sulphur or sulphuric acid from the sulphates of barytes and strontia, and for consequent improvements in the manufacture of carbonates and oxides of soda and potassia."—(Communication.)—19th.

IRISH PATENTS.

Sealed from 21st January, to 19th March, 1851.

William Edward Newton, Office for Patents, 66 Chancery-lane, Middlesex, civil engineer,—"Improvements in obtaining, preparing, and applying zinc and other volatile metals, and the oxides thereof, and in the application of zinc, or ores containing the same, to the preparation or manufacture of certain metals or alloys of metals."—January 22d.

John Ransom St. John, New York, America, engineer,—"Improvements in the process of, and apparatus for, manufacturing soap."—(Communication.)—24th.

James Young, Manchester, Lancaster, chemist,—"Improvements in the treatment of certain bituminous mineral substances, and in obtaining products therefrom."—Feb. 1st.

Peter Claussen, Cranbourne-street, Middlesex, gentleman,—"Improvements in bleaching, in the preparation of materials for spinning and felting, in yarns and felts, and in the machinery employed therein."—(Partly communicated.)—February 1st.

John Clare, Exchange-buildings, Liverpool,—"Improvements in the manufacture of casks."—3d.

Benjamin Rotch, Lowlands, Middlesex, Esq.,—"A factitious saltpetre, and a mode by which factitious saltpetre may be obtained for commercial purposes."—4th.

James Corry, Belfast, damask manufacturer,—"Improvements in machinery or apparatus for weaving figured fabrics, which machinery or apparatus is also applicable to other purposes for which jacquard apparatus is or may be employed."—5th.

Edward Clarence Shephard, Parliament-street, Westminster,—"Improvements in electro-magnetic apparatus, suitable for the production of motive power of heat and of light."—7th.

Zachariah Morley, Regent's-park, Middlesex, Esq.,—"Certain improvements in the means or methods of, or apparatus or machinery for, decomposing water, and applying the products to useful purposes."—(Communication.)—7th.

Jasper Wheeler Rogers, Dublin, civil engineer,—"Certain improvements in the preparation of peat, and in the manufacture of the same into fuel and charcoal."—7th.

John Matthews, Kidderminster, foreman,—"Improvements in sizing paper."—8th.

Thomas Wickstead, Old Ford, Middlesex, civil engineer,—"Improvements in the manufacture of manure."—26th.

Samuel John Pitter, Church Lane, Clapham, civil engineer,—"Certain improvements in umbrellas and parasols."—March 5th.

Charles Xavier Thomas, (de Colmar), chevalier de la Legion d'Honneur, Paris, France,—"An improved calculating machine, which he calls Arithmometer."—10th.

Richard Archibald Brooman, of the firm of Messrs. J. C. Robertson & Co., 166 Fleet-street, London, patent agents,—"Improvements in purifying water, and preparing it for engineering, manufacturing, and domestic purposes."—(Communication.)—11th.

Charles Bury, Salford, Lancaster, manager,—"Improvements in machinery or apparatus for preparing and spinning, doubling or twisting silk waste, cotton, wool, flax, and other fibrous substances."—12th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 13th February, to 18th March, 1851.

Feb. 13th,	2688.	Wm. Richard Hodges, Manchester,—"Iron stretcher for a traveller's bag or portmanteau."
—	2689.	Edward Shingler, Birmingham,—"Wellington boot."
—	2690.	H. J. and D. Nicoll, Regent-street,—"Back, or waistband for trousers."
—	2691.	H. J. and D. Nicoll, Regent-street,—"Coat."
14th,	2692.	John Langford, Birmingham,—"Handle for teapots and other vessels."
15th,	2693.	J. D. Caulcher, Anstruther Villa, St. John's-wood,—"Cork jacket, or life-preserver."
17th,	2694.	Clayton, Shuttleworth, and Co., Stamp-End Works, Lincoln,—"Portable steam-engine."
18th,	2695.	Samuel Messenger, Birmingham,—"Burner for lamps."
19th,	2696.	Henry Bradford and Matthew Frost, Primrose-hill, St. Bride's,—"Amphaton, or doubly-perfected splatterdash."
—	2697.	Wm. Adolphus Biddle, St. John's-square,—"Alarm door and window wedge."
—	2698.	John Hadley, Worcester,—"Sole to cover tires of carriage-wheels."
—	2699.	Joseph Welch and John Margetson, Cheapside,—"The unique braces."
—	2700.	John Morrison, Sheffield,—"Tap for high-service pressure."
—	2701.	Thomas Evans and Co., Wood-street, Cheapside,—"The Queen's parasol."
20th,	2702.	S. Cocker and Son, Sheffield,—"Circular file driven by mechanical power."
—	2703.	S. Pearce, Bath,—"The Sevigne stay."
—	2704.	J. Cartland and Son, Birmingham,—"Swing glass."
—	2705.	H. Room, Birmingham,—"Shower-bath."
21st,	2706.	Thornton and Killick, Ludgate-hill,—"The Amphaton collar."
—	2707.	J. Beasley, Spalding,—"Machine for cutting chicory and other roots."
22d,	2708.	Sharp, Brothers, and Co., Manchester,—"Ring and traveller for a throstle."
—	2709.	J. Warner and Sons, Crescent, Jewin-street,—"Ventilating brick."
24th,	2710.	J. D. Durham, Linton-street, New North-road,—"Hot-air funnel kettle."
—	2711.	J. Hooper and J. Bullock, Mosely, near Birmingham,—"Ventilator."
25th,	2712.	B. Sawdon, Huddersfield,—"Gas retort."

Feb. 26th,	2713.	T. Eyles, James-street, Bath,—"Eyles' folding table."
27th,	2714.	H. and S. Schloss, Friday-street,—"'Multum in parvo' pocket-book, or porte cigar."
28th,	2715.	Charles J. Thrupp and Co., Oxford-street,—"Stanhope landaulet.'
March 1st,	2716.	J. B. Davis, Roupel-Street, Lambeth,—"Clear-way valve."
—	2717.	Samuel Brown, Sheffield,—"Tubular lightning-conductor."
6th,	2718.	William Crosshill, Iron Works, Beverley,—"Wheel nave."
7th,	2719.	Hilliard and Chapman, Glasgow,—"Table-knife with invisible secured handle."
8th,	2720.	William Merritt, Brompton.—"Painter's brush."
10th,	2721.	A. D. V. Canavan, Wyndham-street, Bryanton-square,—"Buff bristles for cleaning and polishing brushes."
11th,	2722.	I. Lusty, Liverpool,—"Pin and needle-case."
—	2723.	Wilson and Matheson, Glasgow,—"The tourist's pocket umbrella."
12th,	2724.	T. Bailey, Birmingham,—"Thumb latch."
—	2725.	J. De la Rue & Co., Bunhill-row,—"Envelope letters."
—	2726.	John Blair, Esq., jun., Camphill, Irvine, Ayr,—"Military, tourist's, and emigrant's portable couch or bedstead."
—	2727.	Edmund Vezey, Bath,—"Box hoop, or cap for carriage spring."
—	2728.	Frederick Ayckbourn and Leopold Cobian, Strand,—"Folding boat."
13th,	2729.	George Holcroft, Manchester,—"Steam boiler."
14th,	2730.	Chas. Marsden, Waterloo-house, Kingsland,—"Syphon funnel."
—	2731.	Perkins and Sharpus, Bell-court, Canon-street,—"Enlarged heating surface bottom for coppers, pots, and kettles."
15th,	2732.	H. S. Rogers, Basinghall-street.—"Child's velocipede carriage."
18th,	2733.	James Philips, Lambeth,—"Greenhouse gas stove."
—	2734.	Thomas Fillary, Coldbath-fields,—"Land-labour machine."
—	2735.	Henry Earushaw, Wimpole-street,—"Dumb jockey."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 1st January, to 19th March, 1851.

Jan. 2d,	1.	J. P. Oates, Lichfield,—"Equitone cornet."
—	2.	A. A. De R. Heley, Manchester-buildings, Westminster,—"Fastener for gloves."
8th,	3.	R. Brotchie, Regent-street, Lambeth,—"Wet repellent boot."
10th,	4.	Henry Wickens, Regent-street,—"Border piece or edging for a parasol."
11th,	5.	Henry Smith, Rufford's-row, Islington,—"Horticultural hot-water gas stove."
14th,	6.	Theodore Jones, Lombard-street,—"Silent alarm bedstead."
15th,	7.	W. M. Bywater, Piccadilly,—"Water meter."
16th,	8.	J. P. Oates, Lichfield,—"Military transposing trumpet."
17th,	9.	Benjamin Browne, Belvedere-row, Lambeth,—"Lock and key."
18th,	10.	James Creak, Wisbech,—"Waterproof Blucher boot."
—	11.	James Creak, Wisbech,—"Waterproof button boot."
21st,	12.	Frederick Futvoye, Regent-street,—"Postage stamp envelope."
22d,	13.	Peter Chalmers, Chamber-street, Goodman's-fields,—"Ale drum."
—	14.	Richard Clayton, Gresham-street,—"Swimming glove for all ages and nations."
24th,	15.	G. J. Newbery, New Oxford-street,—"Door wedge."
—	16.	Richard B. Beauford, St. Leonards and Hastings,—"Daguerreotype accelerator."
—	17.	Lieutenant Julius Roberts, R. M. A., Portsmouth,—"Self-acting swing pier."
25th,	18.	William Rodgers, St. Mary's-street, Walcot-square,—"Bolt protector for buttons and medals."
27th,	19.	John Coope Haddan, Bloomsbury-square,—"Lining or substitute for padding for a railway carriage."
28th,	20.	John Lee Stephens, Copthall-buildings,—"Fire shovel."
—	21.	John Lee Stephens, Copthall-buildings,—"Nipping end of fire tongs."
29th,	22.	Charles Saunders, New-yard, Great Queen-street,—"Double lever wheel plate."
—	23.	W. Dyne, Mansfield-street, Kingsland-road, and C. J. Vickery, Mason-street, New-cross,—"Life-boat."
30th,	24.	Hyam Hyams, Cornhill,—"Object-glass."
31st,	25.	William Bishop, Boston, and Robert Cooke, Huntingdon,—"Elastic tightener for trousers."
Feb. 3d,	26.	Jean F. C. Noel, Bedford-street, Strand,—"Meldoise bridle."
4th,	27.	Andrew Wentzell, Fore-street, Lambeth,—"Life-boat."
5th,	28.	William Bishop, Boston, and Robert Cooke, Huntingdon,—"Horse collar."
6th,	29.	David Stephens Brown, Alexandrian-lodge, Old Kent-road,—"Filtering jug."
—	30.	Edward Gibbons Cooper, Westbourne-street, Pimlico,—"Swimming gloves and life preservers."
—	31.	David Stephens Brown, Alexandrian-lodge, Old Kent-road,—"Fumigating cover."
—	32.	Samuel Thomas Scott, Union-street, Southwark,—"Adjusting last."
—	33.	M. Hyams and Co., Long-lane, Smithfield,—"Exhibition cigar."
7th,	34.	William Bishop, Boston, and R. Cooke, Huntingdon,—"Elastic tightener to stays."
—	35.	Uriah Scott, Upper Charlton-street, Fitzroy-square,—"Silent door and gate spring."
—	36.	Thomas Robert Hill, Church-street, Soho,—"Portable bedroom-door fastener."
8th,	37.	W. M. Bywater, Piccadilly,—"Shifting draught eye."
—	38.	Thomas Cooke Foster, Newcastle-street, Strand,—"Hat."
—	39.	George Gregory Lowe, High-street, Portland Town,—"Self-cleansing sanatory cistern."
—	40.	William Pierce, Manchester,—"Imperial copying press."
—	41.	John Coope Haddan, Bloomsbury-square,—"Handle apparatus for omnibus roof."
—	42.	John Lee Stephens, Copthall-buildings,—"Screw runner fastening for umbrellas and parasols."
—	43.	J. S. Mackenzie, Newark-upon-Trent,—"Vulcan spring for doors."
—	44.	Etienne F. Lorentz, Bedford-street, Strand,—"Rechaud chauffe-rette, or stove foot-warmer."
10th,	45.	S. J. Wilkinson, Jeffrey-square, St. Mary-Axe, and G. V. Wiesdell, Walworth-road,—"Secure fastener."
—	46.	Thomas Gowland, Leadenhall-street,—"Spring-catch fastener for brooches."
Feb. 10th,	47.	Frederick Huxam, Charles Huxam, and J. A. Brown, Exeter,—"Cooking stove."
—	48.	Etienne F. Lorentz, Bedford-street, Strand,—"Rechaud bruloir, or stove coffee roaster."
—	49.	Etienne F. Lorentz, Bedford-street, Strand,—"Rechaud rotissoire, or roasting stove."
12th,	50.	Stephen Geary, Euston-street, Euston-square,—"Variegated lamp."
13th,	51.	Thomas and George Barnes, New-court, Goswell-street,—"The unique braces."
—	52.	Benjamin Browne, Belvedere-road, Lambeth,—"Shirt."
14th,	53.	William Leuchars, Piccadilly,—"Double-action lock."
—	54.	Chas. Henry Moysen, Bedford-street, Strand,—"New irrigator for making graduated and variable furrows."
—	55.	Geo. Gibbs, Bristol,—"Nipple-cover or protector, and hammer for percussion fire-arms."
15th,	56.	Thornton and Killick, Ludgate-hill,—"Amphaton collar."
17th,	57.	Thos. W. Tipler, Rugby,—"Portable fire-escape."
—	58.	David Stephens Brown, Alexandrian-lodge, Old Kent-road,—"Fumigating cover for bushes."
18th,	59.	A. Boucher and Co., South-street, Finsbury,—"Castor."
—	60.	W. M. Bywater, Piccadilly,—"Water-meter."
19th,	61.	Theodore Robert Brunell, Newman-street, Oxford-street,—"Photographic apparatus."
20th,	62.	Henry Inskip, Hertford,—"The United Service flask."
—	63.	T. F. Gates and E. C. Gates, Pimlico,—"Robe pour Dames Mariées."
21st,	64.	T. R. Brunell, 13 Newman-street, London,—"Tap."
—	65.	W. Wharton, Euston-square,—"Noiseless wheel."
—	66.	J. H. Noone and W. Exall, Queen's-crescent, Camden-town,—"Spring-carriage head."
—	67.	D. S. Brown, Old Kent-road,—"Blower."
22d,	68.	W. Muir and H. Goss, Salford, Lancaster,—"Theodolite."
—	69.	J. Mash, Kentish-town,—"Reflecting stove-grate."
24th,	70.	R. Kittan, jun., Rudham, Norfolk,—"Ventilating funnel for liquids."
—	71.	D. S. Brown, Old Kent-road,—"Weighing-machine."
25th,	72.	W. E. Currett, Leeds,—"Portable high-pressure boiler."
26th,	73.	W. Higginbottom, Manchester,—"Joint for water-pipes," &c.
27th,	74.	F. G. Yeates, Winckworth's-buildings, City-road.—"Box for string," &c.
—	75.	F. G. Yeates, Winckworth's-buildings, City-road,—"Lever-knife."
—	76.	J. Gedge, Wellington-street, Strand,—"The bellows stove."
28th,	77.	Charles Bolton, Dorset-street, Portman-square,—"Stitching machine."
—	78.	Thomas Geake, Sherborne,—"Expanding dining-table."
March 1st,	79.	Leonard Hicks, Leeds,—"Hat."
—	80.	William Stahl, Great Pulteney-street, and John Burt, Church-street, Chelsea,—"Self-acting card case."
3d,	81.	R. G. Diamond, Silver-street,—"The 'Koh-i-noor,' or improved omnibus."
—	82.	Duffield Offord, Great Yarmouth,—"Masticating knife and fork."
—	83.	J. C. Jones & Co., Soho-square,—"Twin piano-forte."
—	84.	F. Haysome, Belgrave-terrace,—"Life-boat."
5th,	85.	L. Foucart, M.D., Glasgow and London,—"Chest-expander, or spinal rectifier."
—	86.	W. L. Turner, Cambridge-street, Hyde Park-square,—"Envelope letter."
6th,	87.	W. R. Bangust, Hackney,—"The patulus A'Tergo shirt."
—	88.	I. Anderson, Elgin, N. B.,—"Car."
7th,	89.	B. Black, South Moulton-street,—"Carriage lamp."
8th,	90.	A. and E. Stone, Brompton and Margate,—"Self-acting and regulating effluvia prevention trap."
—	91.	E. Chamault, South-street, Finsbury,—"Stick-smoking pipe."
10th,	92.	H. Hicks, Davies-street,—"Otium saddle."
—	93.	Robertson, Carr, and Steel, Sheffield,—"Radiating and reflecting register stove grate."
—	94.	H. W. Keel, Isle of Wight,—"Calender or date indicator. The hemorascope."
11th,	95.	J. L. Stevens, Copthall-buildings,—"Omnibus ventilator."
12th,	96.	W. F. Ross, Bishopsgate-street Within,—"Peruke spring."
—	97.	J. Abery and T. Denman, North-street, Hackney,—"Water closet."
—	98.	R. Dax, Welshpool, Montgomeryshire,—"Noseband horse stopper."
—	99.	R. Dax, Welshpool,—"Noseband horse stopper."
—	100.	M. Frearson, Paddington,—"Ventilating shield cowl."
13th,	101.	Augustus Adams, Lime-street,—"Sanitary drain trap."
—	102.	Mary Ness, Huddersfield,—"Window-cleaner."
—	103.	Walter Smith, Maidstone,—"Early calling machine."
—	104.	J. Farquharson, Great Ealing,—"Spring stump for a wooden leg."
—	105.	W. S. Adams, Haymarket,—"Tap."
14th,	106.	Hugh Greaves, Manchester,—"Coupling for rails, and for connecting rails to sleepers."
—	107.	Benjamin Clarke, M.R.C.S., Chelsea,—"Anti-apoplectic or self-acting shirt."
—	108.	Henry Laxton, Pall-mall East,—"Parlour cooking stove."
15th,	109.	W. & S. Dingley, Sherborne,—"Protector (coat)."
18th,	110.	William Stahl, Great Pulteney-street,—"Divider and callipers."
19th,	111.	A. R. Peel, Strand,—"Hyppolytic tug (harness)."

TO READERS AND CORRESPONDENTS.

Books Received.—"Colour applied to Decoration." "On the Application of the Sewage Water of Glasgow," &c. "Remarks on the Amendment of the Law of Patents,"—

W. R.—We are afraid we cannot advise him, without being in possession of the special action required. If he will favour us—in confidence—with an outline sufficient to guide us in judging, we shall be glad to assist him.

An Old Correspondent's communication is very acceptable. It will appear in our next part.

E H., Pernambuco.—His "Elliptograph" is not new. It has been repeatedly published. We are in receipt of his communication of January last, and will attend to the several matters next month.

G. R.—Without knowing his position as a student, it would be useless to attempt to advise him. We may state, however, that for the first, he may take "Willis's Principles of Mechanism," and for the second, "Tredgold," and "Bourne's Catechism."

H. W. H.—We shall give the plate as early as possible. At present we cannot name a time for its appearance.

late 70

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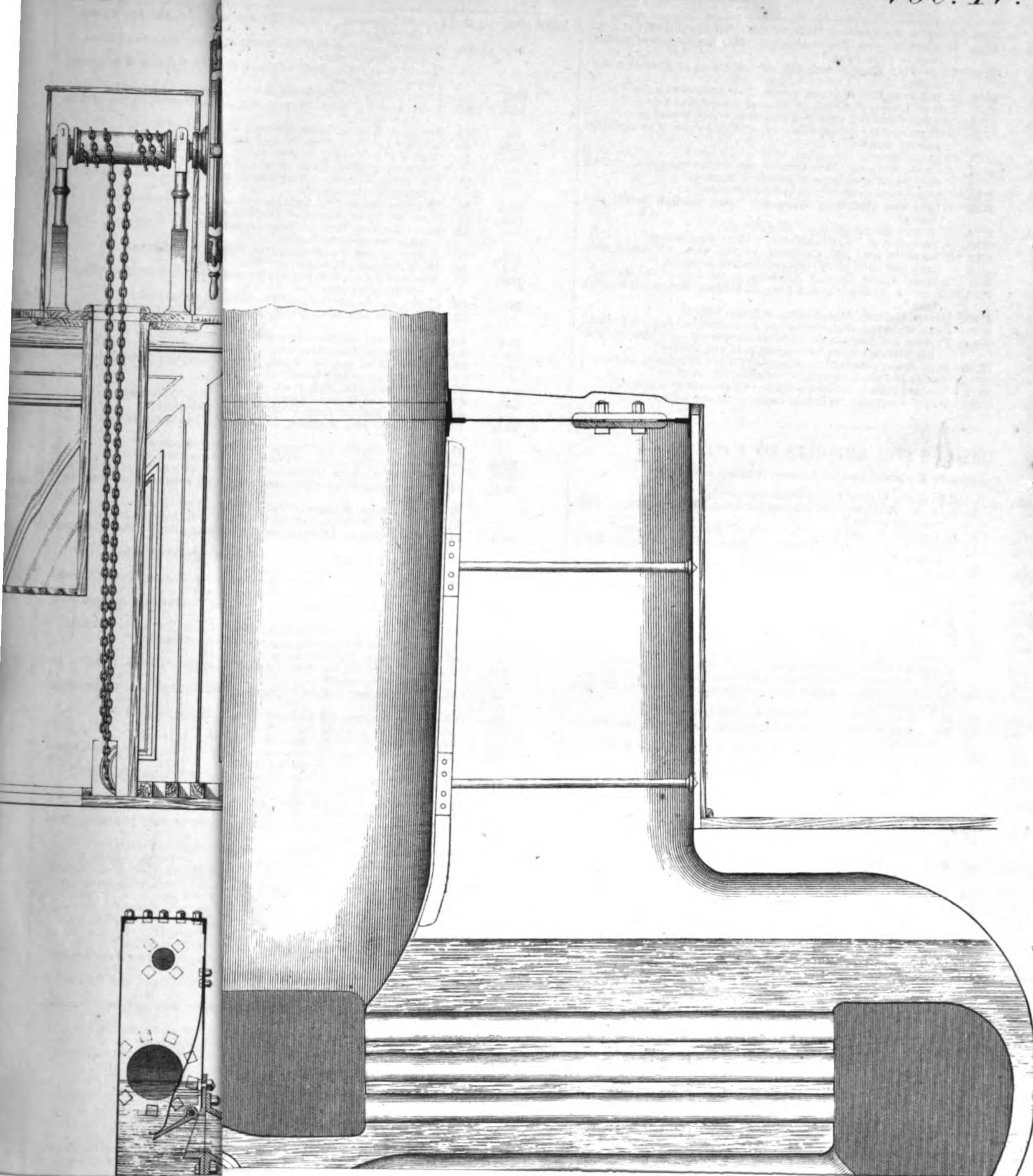
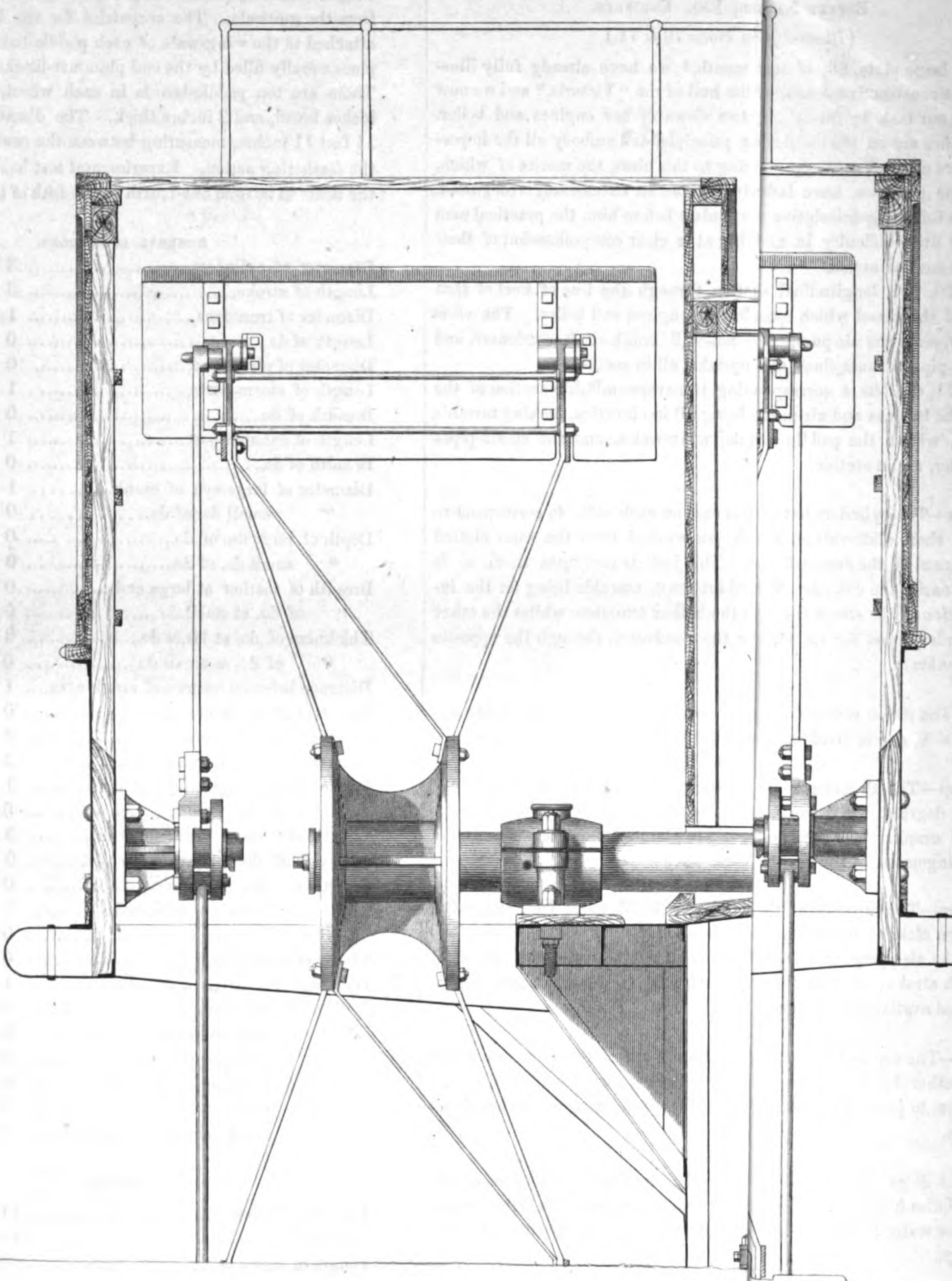




OSCILLATING ENGINES OF THE RIVER STEAMER "VICTORIA."

ROBERT NAPIER, ESQ., ENGINEER.

(*Illustrated by Plates* 70 & 71.)

IN our large plate, 68, of last month,* we have already fully illustrated the constructive details of the hull of the "Victoria," and we now complete our task by furnishing two views of her engines and boiler. The engines are on the oscillating principle, and embody all the important points of excellence appertaining to this class, the merits of which, for marine purposes, have latterly become so extensively recognised. With the following descriptive particulars before him, the practical man will have little difficulty in arriving at a clear comprehension of their arrangement and action.

Plate 70, is a longitudinal section through the line of keel of that portion of the vessel which contains the engines and boiler. The view thus represents the air-pump and hot-well, crank-shaft, condenser, and injection-pipe, furnace-flues, and up-take, all in section.

Plate 71, exhibits a corresponding transverse midship section of the vessel, the engines and air-pump being all in elevation, looking towards the bow, whilst the paddle-wheels, wing-wales, and the steam-pipes from boiler, are in section.

Cylinders—The cylinders have ports cast on each side, to correspond to two short slide-valves, which are worked from the same slotted segment of the eccentric-rod. The jackets cast upon them, as is ordinarily the case, are divided into two, one side being for the induction of the steam through the hollow trunnion. whilst the other affords means for its exit to the condenser, through the opposite trunnion.

Piston—The piston is attached to the rod by means of a nut on the under side, and is fitted with metallic packing, with ten springs.

Air-Pump—The air-pump is set in front of the engines, at an angle of $62\frac{1}{2}$ degrees. It is worked directly from the paddle-shaft by a central crank. The sectioned parts in plate 70 show very clearly the arrangement of the various connections.

Condenser—The capacity of the condenser is 35 cubic feet, measuring down clear of the foot-valve. It is so arranged with a bottom slope to the air-pump, that the latter can draw the water entirely off at each stroke; so that the entire capacity of the condenser is rendered available for action.

Frames—The top and bottom engine frames are of cast-iron, connected together by eight wrought-iron columns, stayed by four diagonal stays, to prevent the oscillation of the top-frame from the crank action.

Feed and Bilge Pumps—These are worked by the outer flanges of the cylinder trunnions, and are fitted with flap-valves. The bilge-pumps draw water from the whole of the water-tight compartments of the ship.

Throttle-Valves and Connections—The handles for the throttle-valves, safety-valve, injection-cock, starting and disengaging gear, are all within the convenient range of the attendant, so that he has the fullest possible command over the movements of the engines. The steam guage is placed opposite the safety-valve handle, which latter is steadied by a graduated bar, for the purpose of lifting one weight of the safety valve to each graduation.

* See page 1, vol. IV.

Paddles—The paddle-wheels, as shown in plate 71, are made on the feathering principle. They are supported in journals carried on the ends of brackets, fastened to the side of the vessel, and projecting from the gunwale. The eccentrics for the feathering action are attached to the wing-wale of each paddle-box, thus occupying the place usually filled by the end plummer-blocks of common paddles. There are ten paddle-boards in each wheel, 6 feet long by $27\frac{1}{2}$ inches broad, and 2 inches thick. The diameter of the wheels is 11 feet 11 inches, measuring between the centres of the spindles of the feathering action. Experimental test has shown the "slip" of the floats to be from one-fourth to one-fifth of the rate of the wheels.

GENERAL DIMENSIONS.

Diameter of cylinders,........................	3	feet	0	inches.
Length of stroke,...............................	3	"	6	"
Diameter of trunnions,.........................	1	"	1	"
Length of do., ...	0	"	6	"
Diameter of piston-rod,........	0	"	$3\frac{3}{4}$	"
Length of steam-ports,.	1	"	$0\frac{1}{2}$	"
Breadth of do.,..................................	0	"	2	"
Length of exhaust-port..........................	1	"	$0\frac{1}{2}$	"
Breadth of do., ...	0	"	$6\frac{3}{4}$	"
Diameter of large eye of crank,.........	1	"	$0\frac{7}{8}$	"
" small do. of do...............	0	"	10	"
Depth of large do. of do.,..............	0	"	8	"
" small do. of do.,......................	0	"	$7\frac{1}{4}$	"
Breadth of feather at large end,............	0	"	$9\frac{1}{2}$	"
" of do. at small do.,...........	0	"	8	"
Thickness of do. at large do.,.......... ...	0	"	$5\frac{1}{2}$	"
" of do. at small do.,................	0	"	$5\frac{1}{4}$	"
Distance between centres of crank eyes,...	1	"	9	"
Diameter of crank-pin,........................	0	"	5	"
Length of do. do. journal,....	0	"	$7\frac{5}{16}$	"
Diameter of air-pump,.............	2	"	3	"
Stroke of air-pump,..............................	1	"	9	"
Diameter of do. rod,.........	0	"	$2\frac{3}{4}$	"
Length of do. connecting do.,..........	3	"	8	"
Diameter of do. crank journal, ...	0	"	$8\frac{3}{4}$	"
Length of do. do.,.................	0	"	$4\frac{5}{16}$	"
" of valve eccentric-rod, ...	3	"	$4\frac{1}{2}$	"
Travel of do.,.................................. ..	0	"	$4\frac{3}{4}$	"
Throw of eccentric, ...	0	"	$4\frac{3}{4}$	"
Diameter of do.,.................................	1	"	3	"
" columns, ...	0	"	$2\frac{9}{16}$	"
" diagonal stays, ...	0	"	$1\frac{9}{16}$	"
" feed-pump plunger, ...	0	"	$4\frac{1}{2}$	"
" do. pipe,...........................	0	"	$2\frac{1}{4}$	"
" steam do., ...	0	"	$6\frac{3}{4}$	"
" crank shaft, ...	0	"	8	"

BOILER.

Length of boiler,.....................	11	feet	0	inches.
Breadth of do.,........	15	"	0	"
Height of do.,.......	7	"	10	"

Number of furnaces,......... 4

Length of do.,.....................................	7	feet	0	inches
Breadth of do.,.....................................	3	"	0	"
Length of tubes, ...	6	"	6	"
Diameter of do. inside,............	0	"	$4\frac{5}{8}$	"

Number of do.,..70.

Distance between centres,	$6\frac{1}{2} \times 6\frac{3}{4}$.		
From furnace tops to centre of first row,	0 feet	$5\frac{1}{4}$	inches.
Water spaces,	0 "	5	"
Diameter of funnel,	3 "	6	"
Square feet of tube surface,	541		
" of heating surface,	434		
Total,	975		

On the trial trip of the "Victoria," in the Gareloch, the rate of motion of the piston was found to be 364 feet per minute. At this speed the engines, although nominally of 75 horse-power, at 200 feet per minute, were actually yielding a power of 136 horses, by the Admiralty rule. The speed of the engines varies with the speed of the vessel. At 52 revolutions, they have brought the vessel's rate up to 17 miles per hour—verified on the measured mile in the Gareloch.

GENERAL VIEW OF MATHEMATICAL ANALYSIS.

The great object of our inquiries in concrete mathematics being the discovery of *equations* expressing the mathematical laws of phenomena, and those *equations* being the real starting-point of the calculus, the object of which is the determination of some quantities by means of others, it appears to be quite indispensable, before going further, to explain more distinctly than has hitherto been done, the fundamental idea represented by the word *equation*, a subject which mathematical labours are always dealing with, either as their end or their origin. Besides the advantage of more completely defining the real field of analysis, there will necessarily result this important consequence, that we shall trace in a more accurate manner the line of demarcation between the concrete and the abstract parts of mathematics—and we shall thus render complete the general exposition of the fundamental division previously established.

When we bestow the name *equation* upon every species of the relation of equality between *any* two functions of the magnitudes under consideration, we attach to it far too vague an idea. For granting that every equation is a relation of equality, yet every relation of equality is far from being an equation, of the kind at least to which analytical methods are really applicable. This want of precision in so fundamental a notion, draws along with it the weighty inconvenience of rendering unexplainable the immense and capital difficulty which meets us when we attempt to establish the relation of the concrete to the abstract. If the meaning of the word were really as extensive as is commonly supposed, there is no reason why we should not be able to establish equations in all problems whatsoever: for the whole thing would seem to consist of a simple question of form, which cannot call for any great mental effort, seeing that we can scarcely conceive of any precise relation that it is not at once a certain relation of equality, or that it may not, at all events, be very soon brought into that state by a few simple changes. And thus, by including every species of *function* in the definition of equation, we can give no account of the extreme difficulty commonly experienced in throwing a problem into the form of a mathematical equation. The truth is, that the abstract and general idea expressed by the word equation, is very different from, because much wider, than the meaning which it imports in the mouths of geometers; and it especially behoves us to rectify this logical error, this defective correlation.

To effect this object, let us first discriminate two kinds of *functions*—*abstract* and analytical functions, and *concrete* functions. The first kind alone enters into mathematical *equations;* so that we might define an equation as being a relation of equality between two *abstract* functions of the magnitudes under consideration. That we may have no need to return to this fundamental definition, and not to leave our idea of these abstract functions incomplete, I will here add, that they may bear relation not only to the magnitudes presented by the problem itself, but also to all other auxiliary magnitudes which are connected therewith, and which may be frequently introduced by mathematical artifices, solely with the view of facilitating the discovery of the equations of the phenomena.

The distinction taken between abstract and concrete functions, may be established in two ways, essentially different, but complementary—*à priori* and *à posteriori;* that is to say, by describing generally the peculiar nature of each species of function, and then by enumerating, as is possible, all the abstract functions known at this day, at least as far as the elements composing them are concerned.

A priori: abstract functions express a mode of dependence between magnitudes which we can conceive as belonging to numbers solely and independent altogether of phenomena, wherein they may be found realised. *Concrete* functions, on the other hand, are those for which the mode of dependence expressed can neither be defined nor conceived, except by assigning some determinate physical case, geometrical, mechanical, or of some other class, in which it actually resides.

The majority of functions, even those which are now the most purely *abstract*, began by being *concrete;* so that is easy to explain the preceding distinction by a reference to the different points of view, from which geometers, during the progress of their science, have successively looked at the simplest analytical functions. Take the case of powers for example; these, speaking generally, have become abstract only since the labours of Vieta and Descartes. The functions, x^2, x^3, which, in present usage, are so well conceived as simply *abstract* in the eyes of ancient geometers, were functions entirely *concrete*, respectively expressing the relation of the superfices of a square, or of the contents of a cube to the length of their sides. They then bore this character so exclusively, that it was only from their geometrical definition that they discovered the elementary algebraical properties of these functions, relatively to the decomposition of the variable, into two parts; properties which at that epoch were entirely geometrical theorems, whereto a numerical sense was not attached until a much later period.

Proceeding to consider the matter *à posteriori*, after having established the general character which renders a function abstract or concrete, the question of ascertaining if any given function is truly abstract, and thence capable of entering into true analytical equations, becomes a simple question of fact, since we are going to enumerate all functions of this kind.

At first sight such an enumeration seems an impossibility—the several analytical functions being evidently infinite in number; but by dividing them into *simple* and *compound*, the difficulty disappears. For if the number of separate functions considered by mathematical analyses be really infinite, they are composed, however, of a very few elementary functions, easily enumerated. The abstract or concrete character of any given function may then be determined by seeing if it consists exclusively of simple abstract functions, or if it embraces others. The following table exhibits the fundamental elements of all our analytical combinations in the present state of the science. Functions of a single variable can, of course, be alone considered; those related to several independent variables being always more or less compound.

Let x be the independent variable, y the correlative variable dependent upon it. The different manners of simple abstract dependance which we can conceive existing between y and x are expressed by the ten elementary formulæ following, each function being coupled with its inverse; that is to say, with that function which would arise from the direct function, by considering x with reference to y, and not y to x.

1st Couple,	$y = a + x$	*Sum* function.
	$y = a - x$	*Difference* function.
2d Couple,	$y = a\,x$	*Product* function.
	$y = \frac{a}{x}$	*Quotient* function.
3d Couple,	$y = x^a$	*Power* function.
	$y = \sqrt[a]{x}$	*Root* function.
4th Couple,	$y = a^x$	*Exponential* function.
	$y = l\,x$	*Logarithmic* function.
5th Couple,	$y = \sin x$	*Direct circular* function.
	$y = \text{arc}\,(\sin = x)$	*Inverse circular* function.*

Such are the elements directly composing all abstract functions known at this day; and yet such as the number is, they are capable of affording an infinity of analytic combinations.

The preceding table, however, must be considered complete merely as regards the present state of mathematical science; since there is no *à priori* reason why the list of simple abstract functions should not be

* With the view of increasing to the utmost the insufficient resource and extent of mathematical analysis, mathematicians reckon this last couple of functions amongst analytical elements. Although this is quite allowable, it must be remarked that circular functions are not exactly in the same position as the other abstract elementary functions. There is this essential difference between them, that the functions of the four first couples are at once simple and abstract, whilst the circular functions, though successively exhibiting both characters, according to the point of view from which we survey them, and the manner in which they are employed, never simultaneously present these two characters. Nevertheless, circular functions have some special qualities which permit us to place them amongst the elements of mathematical analysis.

hereafter increased. The elements of our analysis are more numerous than in the time of Descartes, or even of Newton and Leibnitz. It is at most a century since the two last couples were introduced by John Bernouilli and Euler. New elements will, in all probability, be hereafter admitted. But I will shortly prove that they cannot be very numerous, because their increase gives rise to very great difficulties.

We have now gained a clear idea of what mathematicians understand by an *equation;* and it will be at once comprehended how difficult it is to establish equations of phenomena, seeing that we can only reach that point when we are able to conceive the mathematical laws of these phenomena, by the aid of functions composed exclusively of the analytical functions just enumerated. It is not until then that the problem becomes truly *abstract*, and reduced to a pure question of numbers, these functions being the sole simple relations which we can conceive in numbers regarded in themselves. Up to this point, whatever appearances may indicate, the question remains essentially *concrete*, and excluded from the domain of the calculus. Now the fundamental difficulty of converting the concrete into the abstract consists, for the most part, especially in this, that the number of analytical elements at our command is very small, and yet we are compelled, in spite of their paucity, to represent all the precise relations which the different phenomena of nature exhibit in some of these forms. When we consider the infinite variety which the material world presents, it is easy to see that we must be frequently baffled by the difficulty of the problem. Add also, that these elements having been furnished to us at first by the mathematical consideration of the simplest phenomena, all of them, therefore, having a geometrical origin, we have no *à priori* warranty of their necessary aptness to represent the mathematical laws of any other class of phenomena. But I shall presently explain the ingenious artifice by which this fundamental difficulty, presented by the relation of the concrete to the abstract in mathematics, has been considerably diminished, without entailing the necessity of multiplying the number of the analytical elements.

The true object and real field of abstract mathematics have now been determined, I must now proceed to examine its principal divisions, since we have hitherto been regarding the calculus simply as a whole.

Our first division will be into the two branches, which, for want of more convenient names, I shall term the *algebraical calculus*, or algebra, and the *arithmetical calculus*, or arithmetic; but with the remark that these expressions must be taken in their widest sense, in place of the much narrower meaning usually attached to them.

The complete solution of every problem, the most elementary and the most transcendant alike, is composed of two successive parts, the natures whereof are essentially distinct. In the first, our object is to transform the proposed equations so as to put in evidence the manner in which the unknown quantities are generated by the known quantities—this is the algebraical part. In the second, we have in view to value the formulas thus obtained; that is, to determine at once the value of the numbers sought, previously represented by certain explicit functions of the given numbers—this is the arithmetical part.* It is plain that the latter must follow the former, of which it forms the indispensable complement, since we must obtain the numbers required before determining their values in each particular case. And thus the close of the algebraical part is the starting point of the arithmetical part.

Algebraical calculus and arithmetical calculus differ, therefore, entirely in the end they severally propose They differ no less in the point of view from which they regard quantities, which, in the first, are considered as to their relative values, and, in the second, as to their absolute values. The true spirit of the calculus ordinarily requires that this distinction should be observed with the utmost severity, and that the line of demarcation between the two epochs of the solution should be as firmly drawn as the problem permits. Attention to this rule, much misunderstood, will be always useful, because our efforts will be thereby directed to the real difficulty of the case. The fact, however, is, that the imperfection of the science very frequently obliges us to mingle both processes in solving a problem. But, although it may be impossible to divide the whole of the work into two perfectly distinct portions, one purely algebraical, the other purely arithmetical, the preceding remarks will tend to prevent our confounding the two processes with their different views, however much they may be intermingled.

To sum up as succinctly as possible the distinction I have just explained, we may define algebra as having in view the *resolution* of equations, a definition which, though seeming at first too narrow, is yet sufficiently extensive, provided that we take the expressions in their logical acceptation, that is, as signifying the transformation of *implicit* into *explicit* functions. Arithmetic may, in like manner, be defined as having in view the *evaluation* of functions. By abbreviating the expressions to the utmost, I think I shall be able to give a just idea of this division, by saying that algebra is the *calculus of functions*, arithmetic the *calculus of values;* language I shall henceforth use to avoid periphrastic terms.

It is now easy to comprehend how defective, and even vicious, are the ordinary definitions. The exaggerated importance attributed to signs has very frequently led to the two fundamental branches of the science of calculus being distinguished by the difference of their notation—a distinction absurd in principle and false in fact. Even the celebrated definition given by Newton, who named algebra universal arithmetic, certainly gives a very false idea of the nature of both.

Having marked out the two principal branches of the science of calculus, I must now make a general comparison between the extent, the importance, and the difficulty of these two branches, before considering the calculus of functions, the great object of our study at present.

At first sight, the *calculus of values* (or *arithmetic*), seems to offer as vast a field as *algebra*, since it appears to promise as many distinct problems for solution as there are different algebraical formulæ to value. But a very simple reflection suffices to show that the domain of the calculus of values is, by its nature, infinitely less extensive than that of the calculus of functions. For, in distinguishing functions into simple and compound, it is evident that when we are able to *value* simple functions, the consideration of compound functions no longer presents, under this aspect, any difficulty. Under an algebraical point of view, a compound function plays a very different part from that of the elementary functions composing them, and it is precisely here where spring all the chief analytical difficulties. But in the arithmetical calculus all this is very different. Thus, the number of really distinct arithmetical operations is limited to that of the abstract elementary functions, a list of which, showing how few they are, I have already given. The evaluation of these ten functions necessarily gives that of all the functions, infinite in number, that are dealt with throughout mathematical analysis, at least, in its present condition. To whatever formulas the elaboration of equations may lead, new arithmetical processes will only arise if new analytical elements should be discovered, and the number of these, happen what may, will always be extremely small. The field of arithmetic is, therefore, from its nature, very small, whilst that of algebra is indefinite.

It is, however, important to remark, that the domain of the calculus of values is, in reality, much more extensive than is commonly represented. For several problems, really *arithmetical*, since they consist of *evaluations*, are not usually classed as such, because we are in the habit of treating them incidentally, amongst analytical researches more or less elevated; and here that erroneous opinion as to the great importance of signs, previously alluded to, is again the cause of a confusion of ideas. Thus, both the construction of a table of logarithms, and the calculation of trigonometrical tables, are true arithmetical operations of a high order. In the same category, but of a distinct and still higher order, must be ranked all the processes by which we directly determine the value of any function whatever, for each particular system of values assigned to the quantities on which it depends, when we are unable to get at the explicit form of that function. Under this point of view, the *numerical* resolution of the equations which we cannot resolve *algebraically*, and, in like manner, the calculation of the definite integrals, the general integrals of which we are unacquainted with, really fall, in spite of appearances, within the domain of *arithmetic*, in which must be comprehended everything which has for its object the *evaluation* of functions. The considerations relative to this end are, in fact, ever homogeneous (whatever be the evaluations in question), and always quite distinct from considerations truly *algebraical*.

To complete the idea of the actual extent of the calculus of values, we must include that part of the general science of calculus which at this day bears the special name of the *theory of numbers*, as yet in an undeveloped state. This branch, extensive in its nature, but of little importance in the general system of the science, aims at discovering the properties inherent in numbers in consequence of their values, and independently of any particular notation. It, therefore, constitutes a kind

* Suppose, for example, that a question furnishes between an unknown quantity, x, and two known quantities, a and b, the equation, $x^3 + 3\,a\,x = 2\,b$, as would happen in the case of the trisection of an angle. We see that the dependence between x on the one part, and a and b on the other, is completely determined; but as long as the equation preserves its primitive form, we do not perceive in what manner the unknown element is derived from the known elements. This, however, must be discovered before proceeding to obtain the values. This is the object of the algebraical part of the solution. When, after a series of transformations which, step by step, have rendered this derivation more and more apparent, we have thrown the equation into the form

$$x = \sqrt[3]{b + \sqrt{b^2 + a^3}} \qquad + \sqrt[3]{b - \sqrt{b^2 + a^3}}$$

the office of the algebraical part is ended, and though we cannot effect the arithmetical operations indicated by this formula, nevertheless we have obtained an accession of knowledge which is frequently of great importance. It is now the duty of arithmetic, starting with this formula, to find the number x, when the values of the numbers a and b are fixed.

of *transcendental arithmetic*. Newton's proposed definition of algebra would exactly suit it.

The whole domain of arithmetic is, therefore, in reality, much more extensive than is usually supposed. But, whatever developement may be legitimately accorded to it, it nevertheless remains certain that in the entirety of abstract mathematics, the calculus of values will never be anything but a point in comparison with the calculus of functions, of which the science essentially consists. This assertion will be still more apparent from the observations I proceed to make as to the real nature of arithmetical questions in general, when they are thoroughly examined.

In seeking to determine with exactitude in what evaluations peculiarly consist, we soon perceive that they are nothing else than real transformations of functions to be valued, transformations which, notwithstanding their special object, are not the less of the same nature essentially as all those indicated by analysis. Under this point of view the calculus of values may be conceived as simply an appendix to, and a particular application of, the calculus of functions, so that arithmetic would be lost, so to speak, as a distinct section in the entirety of abstract mathematics.

The better to comprehend this consideration, we must observe that when we propose to value an unknown number of which the mode of formation is given, it is by the simple enunciation of the arithmetical question already defined and expressed in a certain form; and that in valuing it we can only throw its expression into another determinate form, to which we are in the habit of referring the exact notion of each particular number by placing it in the regular system of notation.

The sum of the preceding remarks may be given by saying, that the evaluation of a number is nothing more than throwing its original expression into the form

$$a + b\varsigma + c\varsigma^2 + d\varsigma^3 + e\varsigma^4 \; . \; . \; . \; . \; + p\varsigma^m,$$

ς being usually equal to 10, and the coefficients, a, b, c, d, &c., being integral numbers less than ς, liable to become zero, but never negative. Therefore, every arithmetical question is capable of being stated as if it consisted in throwing into a given form any abstract functions of diverse quantities, which are themselves assumed to possess a similar form. We may therefore see in the different operations of arithmetic, nothing but simple particular cases of algebraical transformations, saving the special difficulties appertaining to the conditions connected with the state of the coefficients.

Abstract mathematics, then, are essentially composed of the *calculus of functions;* and *that*, it was already evident, is its most important, extensive, and difficult part. Such, therefore, will henceforth be the exclusive subject of our consideration; and without attending further to the *calculus of values*, I shall at once proceed to examine the fundamental division of the *calculus of functions*.

The real difficulty of obtaining an *equation* from mathematical problems has been already explained. The insufficient number of analytical elements in our power is the reason why the relation of the concrete to the abstract is so difficult to establish. Let us now endeavour to comprehend the general process by which we succeed in surmounting this fundamental obstacle in a great number of important cases.

When we directly consider the whole of this capital question, we are naturally led to consider whether there is not some method of facilitating the formation of the equations of phenomena. Since the principal obstacle arises from the very small number of our analytical elements, why not form new ones? This notion, however, will be found, on closer examination, to be but illusory. It may, indeed, be useful to some extent, but we may soon be convinced of its short-comings.

The formation of a really new abstract elementary function of itself, presents the greatest difficulty. In such a notion there is even something apparently contradictory. For a new elementary element would evidently not fulfil the essential conditions peculiar to it, if we cannot *value* it at once. Now, how are we to *value* a new function which shall be a really *simple* one; in other words, which does not enter into any combination of those already known? This seems to be almost impossible. Hence, the introduction of another abstract elementary function (or rather of another couple of functions, since each is always accompanied by its inverse), necessarily supposes the simultaneous creation of a new arithmetical operation, and that is certainly very difficult.

If we seek for a clue to the invention of new analytical elements in the processes whereby those which we possess were obtained, we are left in a state of uncertainty, for the artifices already employed are evidently exhausted. To convince ourselves of this, let us consider the last couple of simple functions introduced into analysis, viz., the fourth; for, as I have already explained, the fifth couple does not, properly speaking, afford really new analytical elements. The function a^x, and consequently its inverse, were formed by looking at a function known long previously, under a new point of view, namely, the function of powers, when the idea has been sufficiently generalised. By considering a power with reference to the variation of the exponent, instead of with reference to the variation of the base, a really new simple function results, the variation now pursuing a totally different path. But this artifice, as simple as it is ingenious, will not lead to anything more; for on treating all our analytical elements in the same way, the result is merely to make them pass into each other.

We cannot, therefore, at all conceive how we must proceed to form new elementary abstract functions, properly fulfilling all the necessary conditions. We must not, however, be understood to say, that we have gone as far as we can go. Nay, it is certain that the latest special improvements in mathematical analysis have contributed to extend our resources in this respect, by introducing into the domain of the calculus certain definite integrals, which, in some respects, take the place of new simple functions, although they are far from fulfilling all the appropriate conditions, and, therefore, I have not placed them in the list of true analytical elements. But when everything is well considered, I am quite of opinion that the number of these elements can be but very slowly augmented. By such a process only have we hitherto obtained our most powerful resources for the formation of equations.

This mode of proceeding, then, being passed by, it is clear that only one other remains. Seeing the impossibility of directly finding equations between given quantities, we are led to seek for corresponding quantities amongst other auxiliary quantities connected with the first by a certain law; and then to mount from the relation of the two quantities to that of the original magnitudes. This conception has been eminently fruitful, and has constituted our most admirable instrument for the mathematical exploration of natural phenomena—the *analysis* termed *transcendental*.

As a general theory, the auxiliary quantities introduced in place of the original magnitudes, or concurrently with them, to facilitate the formation of the equations, may be derived according to any law whatsoever of the immediate elements of the problem; and thus, this conception has a much greater importance than is commonly supposed, even amongst profound mathematicians. It is extremely important to represent it in its entire logical extent, because it is perhaps by establishing a general mode of *derivation* other than that to which we have been hitherto limited, although not the only one possible, that we shall hereafter succeed in essentially improving the whole of mathematical analysis; and consequently discover still more powerful means for the investigation of the laws of nature than those we now possess, seeing that the latter are probably capable of being exhausted.

But confining ourselves to the present constitution of the science, the only auxiliary quantities habitually introduced, in place of the original quantities in transcendental analysis, are those termed *infinitely small*, the *differentials* of the different orders of these quantities, if Leibnitz's mode of looking at the matter be adopted; or the *fluxions*, the *limits* of the relations of the simultaneous augmentations of the original quantities mutually compared; or, more briefly, the first and last ratios of these augmentations, adopting the language of Newton; or rather, in the last place, the desired functions of these quantities; that is, the coefficients of the different terms of their respective augmentations, in the conception of Lagrange. These three modes of looking at our actual transcendental analysis, and all the others, less widely distinguished from one another, which have been successively proposed, are by their nature necessarily identical, both in the calculus itself and in the application. As to their comparative value, Leibnitz's scheme has in practice an incontestable superiority, but with a logical character eminently vicious; whilst that of Lagrange, admirable for its simplicity, its logical perfection, and the philosophic unity which it has established throughout mathematical analysis, up to his time separated into two departments almost independent, is attended with serious inconveniences in its application, and throws obstacles in the way of our progress. Newton's plan lies between the two, being less rapid, but more rational, than that of Liebnitz; less philosophic, but better adapted for use, than that of Lagrange.

This is not the place for explaining with precision how the consideration of this class of auxiliary quantities, introduced into the equations in place of the original magnitudes, actually facilitates the analytical expression of the laws of phenomena. I must here limit myself to a consideration of this conception in the most general way, in order to deduce therefrom the fundamental division of the calculus of functions into two parts essentially distinct, the connection of which, for the complete solution of a mathematical problem, is invariably determined. Under this relation, and in the natural order of ideas, transcendental analysis presents itself as being necessarily the first, because its object is generally to facilitate the formation of equations, and this should evidently precede the *resolution* of these equations, which is the object of the ordinary analysis. But although it is of the first importance thus to conceive the true connection of the two analyses, it is not the less convenient, con-

formably to general custom, to postpone the study of the transcendental analysis to that of the ordinary analysis; for it is clear that, as the employment of the former in the solution of problems always requires to be completed by more or less aid derived from the latter, we should be obliged to leave the problems unsolved, if the ordinary analysis had not been previously studied.

The calculus of functions, or algebra (taking the word in its widest sense), is composed of two distinct fundamental branches, one of which has for its immediate object the *resolution* of equations, when these have been established; whilst the other, beginning with equations, generally much more easy to establish, between the quantities indirectly connected with those of the problem, has for its constant and peculiar aim to deduce therefrom by invariable analytical processes, the corresponding equations between the direct magnitudes under consideration, when the problem enters the domain of the preceding calculus. The first calculus is usually termed *ordinary* analysis, or *algebra;* the second constitutes what is called the *transcendental analysis*, or, according to the point of view from which it is surveyed, *infinitesimal calculus*, *calculus of fluxions and fluents*, &c. To keep clear of irrelevant considerations, I propose to style it the *calculus of indirect functions*, and to term the ordinary analysis the *calculus of direct functions.* These expressions, formed by generalising and summing the ideas of Lagrange, are intended to indicate with exactitude the true general character peculiar to each analysis.

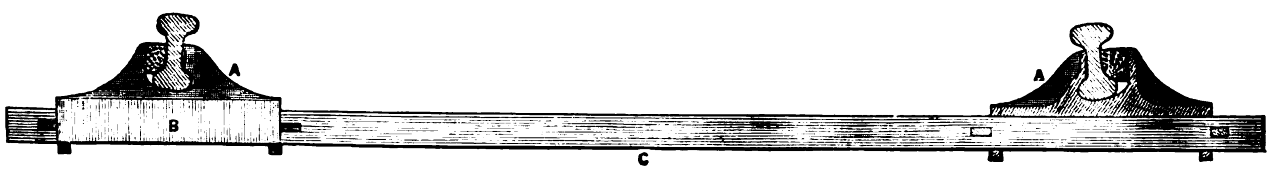
MARCHAL'S IMPROVEMENTS IN THE PERMANENT WAY OF RAILWAYS.

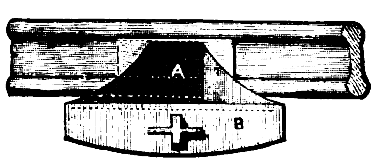
The low price of iron is beginning to have its effect upon a vast variety of the details of engineering construction, and many new and curious applications of this material are constantly presenting themselves. In point of economy and security, one of the most important of its modern adaptations is to the permanent way of railways; examples of which have latterly become pretty familiar to us. So far back as 1841, M. Marchal, a Belgian engineer, had his attention drawn to the subject, by the excessive cost of renewing the sleepers on the different lines with which he was connected; the oak of which they were made being found to decay very rapidly, whilst the timber was difficult to meet with, even at the price of 6s. or 7s. per sleeper.

M. Marchal's plans for the substitution of iron for timber, were patented in England and Scotland in 1842–3, in the name of M. Guitard, under the title of "Certain Improvements in the Construction of Railways," and have been brought into general use on several of the leading continental lines of France and Belgium, and in particular upon the state line from Brussels to Antwerp. On the latter line, the sleepers have been in use for a lengthened period, under an immense traffic; and their present good condition fully justifies M. Marchal's claim as the originator of so durable and economical a plan of permanent way.

M. Marchal's arrangements are applicable as well to new lines as to those already in existence. For new lines he recommends two modifications, which are delineated in the engravings, figs. 1 to 6. Fig. 1 is a transverse section of a pair of rails, one of the chairs being also represented in section. Fig. 2 is a longitudinal or side elevation of one of

Fig. 1





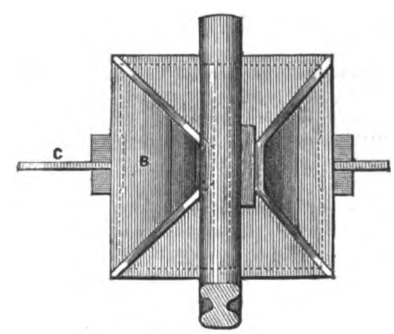
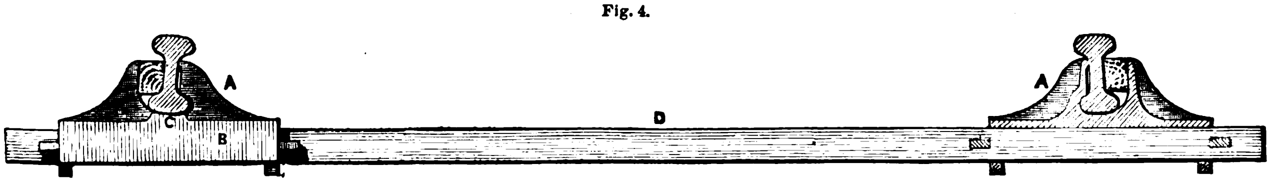


Fig. 2. 1-12th. Fig. 3

the sleepers and rails; and fig. 3 is a corresponding plan of the same parts. The chairs, A, into which the rails are secured by wooden wedges in the ordinary way, are cast with a wide base, B, to give an extended bearing surface for carrying the rails. The guage and parallelism of the rails, and the cant or tilt, are preserved by a transverse wrought-iron bearer, C; each end of which is passed through the base of the chair, and secured by pins, bolts, or keys. With the same number of bearers as in ordinary roads laid with transverse sleepers, the base-plate, B, of the chairs is about 14 inches square, or upwards, according to the nature and extent of the traffic; and, under the same circumstances, the weight of a chair, with wrought-iron bearer, or tie, will be about 100 lbs.

Fig. 4 is a transverse section of a pair of rails, supported in chairs cast with a longer base, to be used as longitudinal bearers; and figs. 5 and 6 are, respectively, a plan and longitudinal elevation of a single chair and rail. The chair, A, is cast in the centre of the long base, B, which has upon it a continuous longitudinal rib, or raised surface, C, upon which the rail bears throughout the entire length of base. As in

Fig. 4.



1-12th.

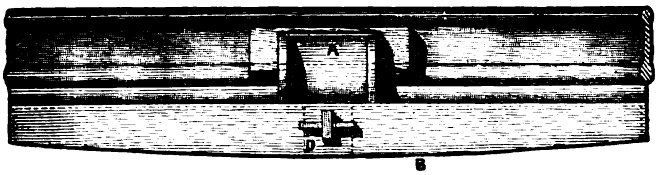
the first plan, the whole is bound and secured by the bearer or tie, D. In relaying an old line, either of the above systems may be adopted, by an arrangement for the old chair being bolted to the new base-plate.

In order still further to simplify the construction of an iron way adapted to the roads at present in existence, M. Marchal has adopted a wrought-iron transverse sleeper, delineated in figs. 7, 8, and 9, the relaying being effected precisely as it would be with timber sleepers—a point hitherto overlooked. Fig. 7 is a plan of a single sleeper with its chairs and rails; and figs. 8 and 9 are side elevations of the same, but showing different sections of sleepers. The chairs, B, are secured to the sleeper, A, by bolts, C, which are ingeniously made eccentric at the part

next the head; so that, whilst the sleepers come on the ground with the bolt-holes ready punched, the chairs may be accurately adjusted to the guage by a slight turn of the eccentric portions of the bolts.

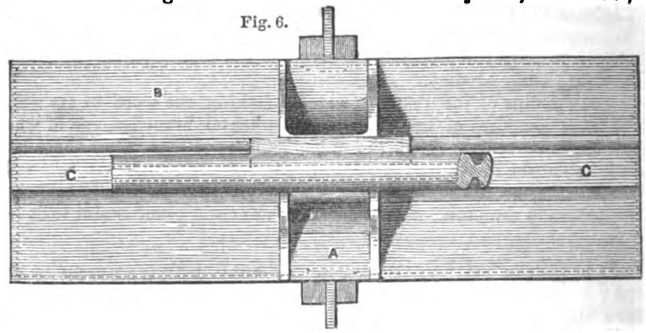
The rise of the price of iron in 1844–5, sufficiently accounts for the non-introduction of these improvements into this country; but having undoubted confidence in the ultimate superiority of the iron road, M.

Fig. 5.



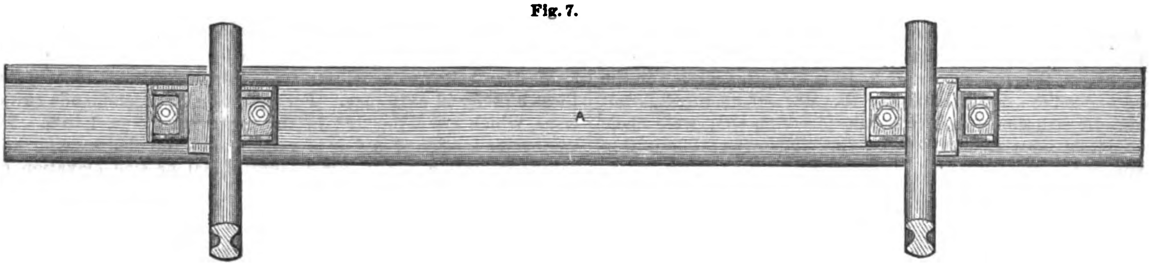
Marchal proposes now to avail himself of the modern cheapness of the material for securing the immediate extension of his system; the more so,

Fig. 6.



as he has met with many imitations and infringements of his patent—arising, as M. Marchal is willing to believe, more from inadvertence, than from any intended evasion of his rights. The points of advantage as to first cost, economical maintenance, durability, and reduced wear to the rolling

Fig. 7.



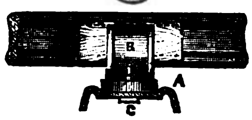


Fig. 8. 1-16th.

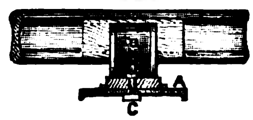


Fig. 9.

stock, secured by plans of permanent way on this principle, have long been decided; and M. Marchal's continental experience fully bears out the favourable views in regard to iron roads which are now so fully recognised.

ON CALCULATING THE USEFUL EFFECT OF STEAM-ENGINES.

III.

I shall next proceed to examine the case of the "Salamander," of which full particulars are given at page 127 of the Appendix. It is there mentioned that her paddle-wheels were 21 feet diameter, the paddle-boards 2 feet 6 inches deep, by 8 feet 9 inches broad, and that there were 16 of them in each wheel. When tried at Woolwich, the greatest immersion of the floats was 5 feet 6 inches, the number of strokes made by the engines 15, and the speed 8.15 statute miles per hour. We also find, at pages 43 and 76 of the Appendix, that the engines of the "Salamander" are of the same dimensions as those of the "Medea." Our data are, therefore,

$$v^1 = 8.15$$
$$V = 11.953$$
$$N = 15$$
$$\epsilon = 7.6097$$
$$m = 16;$$

we also find, from the diagram,

$$A = 20.895$$
$$y = 9.306$$
$$\chi = 0.5568.$$

Assuming, then, the steam to have been generated from fresh water, and the evaporation as well as the other notations to be the same as in the case of the "Medea," we obtain, having $v = 150$,

$$r = 2268.678, \text{ and}$$
$$R = 15092.8;$$

whence we derive, as

$$\epsilon\, y\, \frac{A\, N\, m}{30} = 11837.569$$
$$\psi + 2\,\varphi = 0.2749;$$

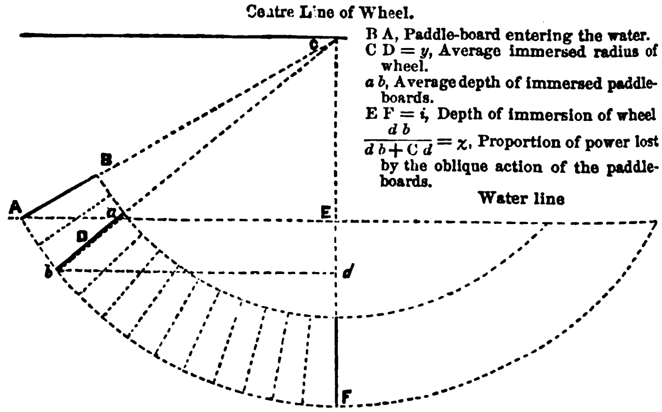
and the joint effect of the two engines = 328.016 horse power. We further find

$$\Phi F + \varphi O = \frac{A\, m\, y}{\pi V}(1 - \chi) = 36.72;$$

whereas for the "Medea," with the same immersion,

$$\Phi F + \varphi O = 48.179.$$

Centre Line of Wheel.



B A, Paddle-board entering the water.
C D = y, Average immersed radius of wheel.
$a\,b$, Average depth of immersed paddle-boards.
E F = i, Depth of immersion of wheel
$\frac{d\,b}{d\,b + C\,d} = \chi$, Proportion of power lost by the oblique action of the paddle-boards.
Water line

It appears, therefore, that if the two vessels are of the same size, and the wheels placed in the same relative positions—the first of which suppositions cannot be correct, if the tonnage is anything to go by—the "Salamander" is the better-sailing vessel by 23.7 per cent.; that is, whilst it would require 149.598 H. P. to propel the "Medea" at the rate of 8.15 miles per hour, as a sailing vessel, 114.019 H. P. would suffice for producing the same effect upon the "Salamander." The joint effect of the engines of the "Medea," if propelled at the rate of 8.15 miles per hour, by Morgan's paddle-wheels, being 208.867 H. P., whilst the joint effect of the engines of the "Salamander," for producing the same result, under similar circumstances, but with radiating paddle-wheels, is 328.016 H. P., as before stated; we find that, in the two cases, the power is respectively distributed as follows:—

In the "Medea,"	Horse power.
Applied to effective propulsion, - - - - -	149.598
Lost by the passage of the floats through the water, -	59.269
Total, - -	208.867

In the "Salamander,"	
Applied to effective propulsion, - - - - -	114.019
Lost by the oblique action of the floats, - - -	143.243
Lost by the passage of the floats through the water,	70.754
Total, - -	328.016

Should the diameter of the cylinders of the "Medea" and "Salamander" really be 55½ inches, as stated at page 43 of the Appendix, and not 4 feet 6 inches, as mentioned at page 76, the substitution of those dimensions will, of course, reduce the velocity of the paddle-wheel shaft. And under all circumstances, it is evident that a very slight increase or decrease of the evaporation must affect the working of the engines to a very perceptible extent. It is scarcely necessary to observe, that having once carefully ascertained the friction of the engine unloaded, the pressure of uncondensed vapour in the cylinder, the amount of clearance, and the additional friction owing to the load, there is no difficulty in working the engines to the greatest advantage for any given evaporation. And it will be easy to compare the sailing qualities of any two steamers, however different the construction of their engines and paddle-wheels may be.

As another example of a steamer propelled by radiating paddle-wheels, I shall take the liberty of investigating the performances of the "Dee," of which particulars are given at pages 43, 47, and 64 of the Appendix. According to the statements contained at page 43, the dimensions of the engines of the "Dee" are—

Diameter of cylinder - = 4 feet 5¾ inches.
Length of the stroke - = 5 feet.

As regards the evaporation, we find, at page 64, that the consumption of fuel was (the engines working at full power) 20 bushels of coals each per day; so that, if we again assume 7 lbs. of coals for the evaporation of one cubic foot of water, it appears that the evaporation amounts to 1.904 cubic feet per minute for each engine. We are, in this case, saved the trouble of conjecturing whether the steam was generated from salt water, or from fresh water. It is stated, at page 64, that the pressure on the safety-valves was 3½ lbs., consequently the total pressure 18.21 lbs. to the square inch; and it will be found that when the engines are making 16 strokes per minute, the pressure in the cylinder is equal to the pressure in the boiler. If, therefore, the steam were generated from sea water, its relative volume would be less, and the engines could not work at that velocity for the given pressure; whilst, under the circumstances mentioned, the volume and pressure of the steam, as generated from fresh water, exactly correspond.

On reference to page 47, we find that the "Dee" was furnished with paddle-wheels 19 feet 4 inches in diameter, each wheel being provided with 16 paddle-boards of 10 feet in length, and 2 feet in depth; that the dip or immersion of the boards was 1 foot 6 inches; and that, when the engines were making 23 strokes per minute, the "Dee" was propelled at the rate of 10.61 English miles per hour. Our data are, therefore,

$$S = 1.904$$
$$a = 15.757$$
$$l = 5.$$
$$N = 23$$
$$v = 230;$$

and if we give to p and f the same values as before, we find

$$r = 1114.575.$$

We have further given

$$v^1 = 10.61$$
$$V = 15.576; \text{ therefore,}$$
$$\varrho = 6.4669, \text{ and}$$
$$R = 8644.444.$$

From the diagram we find

$$A = 10.8125$$
$$y = 9.126; \text{ and as}$$
$$m = 16,$$

we obtain

$$\varrho\, y \frac{A\, m\, N}{30} = 7827.906; \text{ consequently,}$$

$$\Phi + 2\,\varphi = 0.10431;$$

and the joint effect of the two engines is = 249.29 horse power.

We may next ascertain what would be the maximum velocity the vessel could attain, at the immersion of 1 foot 6 inches, and with the given evaporation. It is evident that the loss of power is least when $\varrho = y$; and as we have, in that case,

$$(22.)\quad N \; \frac{30\, a\, l\,(\frac{n}{q} + p + f)}{(1+\delta)\,(1+\Phi'+2\,\varphi)\,A\, m\, \varrho^3 \pi}$$

$$\sqrt{4\left\{\frac{15\,(1+\delta)}{a l(\frac{n}{q}+p+f)}\right\}^2 (1+\Phi'+2\varphi)\,\frac{A\, m\, \varrho^3 \pi}{900}\;\frac{l}{l+c}\,\frac{S}{30(1+\delta)9}+1}-1$$

we obtain

$$N = 16.81$$
$$v^1 = 10.956;$$

it appears, therefore, that the engines would work to the greatest advantage when making 16.81 strokes per minute, in which case the speed of the ship would be 10.956 miles per hour.

Finally, as it is stated, at page 64, that on one occasion, when the engines of the "Dee" were making 16 strokes per minute, she was propelled at the rate of 8 knots, or 9.2 miles per hour, in a calm; we may ascertain what must have been the average immersed radius, and the dip of the wheel, under those circumstances. Since

$$A = 2\, b\, (d - y);$$

where b stands for the length of the paddle-boards, and d for the radius of the wheel, we have

$$(23.)\qquad y = \sqrt{\frac{d^2}{4} - \frac{30\, R}{2\, b\, \varrho\, m\, N\,(1+\Phi'+2\varphi)}} + \frac{d}{2};$$

and as, for the case in point,

$$d = 9.6666$$
$$b = 10; \text{ also}$$
$$V = 13.4933, \text{ and}$$
$$N = 16; \text{ therefore,}$$
$$\varrho = 8.0532$$
$$r = 1858.511;$$
$$R = 11606.9587;$$

we find, making $\Phi + 2\,\varphi = 0.1295$;
approximatively,

$$y = 8.818;$$
$$A = 16.96$$
$$i = 2.16 \text{ (immersion in feet)}$$
$$\chi = 0.2526;$$

and the joint effect of the two engines, 284.059 horse power.

It is not anywhere mentioned what was the usual pressure of the steam in the boilers connected with the engines of the "Medea" and "Salamander;" but as the engines of the latter were working at the rate of 15 strokes per minute, during the experiment tried at Woolwich, that pressure must have been more than 21.75 lbs. to the square inch, inclusive of the atmospheric pressure. Without investigating, for the present, what would be the effect upon the machinery, and the hull of the vessel itself, if the engines were to make from 60 to 80 strokes per minute, I wish to show at what velocity the "Medea" could be propelled, at the immersion of 5 feet 8 inches, with the same engines, and the same amount of evaporation, by the application of an expansive apparatus, so adjusted as to cause the engines to work at the velocity corresponding to the absolute maximum of useful effect, for a pressure of steam in the boiler of 20 lbs. to the square inch.

We should have, in that case,

$P = 20 \times 144 = 2880$ lbs., the pressure of steam in the boiler;

$\frac{l'}{l} = \frac{n + q\,(p+f)}{n + q\,P} = 0.2194$, that portion of the stroke at which the steam is cut off; consequently,

$k = 2.1748$. Also,

$\frac{1}{n + q\,P} = 1177.41$, the relative volume of the steam; therefore,

$v = 578.355$, the velocity of the piston in feet per minute; and

$2\, a\, r\, v = 17995729.106$, the useful effect of the two engines in lbs. raised one foot per minute.

As it is evident that the velocity of the ship will be a maximum when $\varrho = y$, we have

$$(24.)\quad N = \sqrt{\frac{30\, a\, r\, v}{\varrho^3\, A\, m\, \pi\,(1+\Phi'+2\,\varphi)}};$$

and therefore, in this case, assuming

$$\Phi' + 2\,\varphi = 0.2724$$
$$N = 19.358;$$

whence it appears that it would be necessary, instead of connecting the engines directly with the paddle-wheel shaft, to reduce the speed of the latter in the proportion of 1 to 2.987, by gearing, for instance, as in

water-wheels; an arrangement which would, at the same time, admit of the dip of the paddle-boards being adjusted according to the draught of the vessel. By these means we should obtain

$$v^1 = 14.742 \text{ miles},$$
$$V = 21.622;$$

and the joint effect of the engines would be 545.325 horse power.

With a view to exhibit still further the advantages to be derived from the use of high-pressure steam, and the application of an expansion gear, I shall next show at what velocity the "Medea" could be propelled under the same circumstances as before, but with the steam at a pressure of 41.75 lbs. to the square inch, and an amount of expansion corresponding with the absolute maximum of useful effect. In this case we should have

$$P = 6012$$
$$\frac{l'}{l} = 0.1$$
$$k = 2.613$$
$$\frac{1}{n + q\,P} = 580.333; \text{ therefore,}$$
$$v = 511.843, \text{ and}$$
$$a\,r\,v = 12874977.0475.$$

And since, approximatively,

$$\Phi' + 2\,\varphi = 0.2426, \text{ we obtain, for } \epsilon = y, \text{ as before;}$$
$$N = 23.433; \text{ and}$$
$$v^1 = 17.886 \text{ miles per hour as the velocity,}$$

with a reduction of speed between the crank-shaft of the engines and the paddle-wheel shaft, in the proportion of 1 to 2.184.

Finally, I shall venture to make a calculation as to the power which would be required to propel the "Medea," under the circumstances above-mentioned, at the velocity of 30 miles per hour, upon the supposition that steam-engines could be constructed upon such a principle, that although capable of producing the required effect, they would not surpass those of the "Medea" in weight, nor be prevented from working at any required velocity by those serious impediments which set a barrier to the advantageous application of all other kinds of steam-engines. As to high-pressure steam, it is more and more admitted, I believe, that, with properly-constructed boilers and careful management, its use is not attended with greater danger than that of low-pressure steam, whether by sea or land.

For the purpose mentioned, I shall then assume a pair of steam-engines of the following dimensions, viz.:

Diameter of cylinder, - - 6 feet.
Length of stroke, - - - 4 „

As we have

$$v^1 = 30, \text{ and}$$
$$V = 44, \text{ we find}$$
$$\Phi' + 2\,\varphi = 0.188;$$

and making $\epsilon = y = 10.6660$, as already said, we obtain

$$N = 39.391;$$

and because

$$(25.)\qquad \epsilon^3\,\frac{A\,m\,N^2\,\tau}{15}\,(1 + \Phi' + 2\,\varphi) = 2\,a\,r\,v,$$

the joint effect of the two engines would have to be

2108.084 horse power.

To produce this, with the steam cut off at 0.06 of the stroke—which amount of expansion is to correspond with the absolute maximum of useful effect—the steam employed must be at the pressure of 76.17 lbs. to the square inch, and the quantity of water consumed by each engine (in the shape of steam), would be 4.903 cubic feet per minute. We have, therefore, the following data—

$$a = 28.274$$
$$l = 4.$$
$$S = 4.903$$
$$\frac{l'}{l} = 0.06; \; k = 2.8019$$
$$\frac{l}{l' + c} = 9.0909$$
$$P = 10969$$
$$\frac{1}{n + q\,P} = 322; \text{ consequently,}$$
$$v = 507.611.$$

The speed of the paddle-wheel shaft would therefore have to be reduced in the proportion of 1 to 1.6107.

With 320 tons of coals, the "Medea" could, consequently, perform a voyage of 5220 miles in calm weather, upon the supposition that her speed remained the same; whilst it would, of course, increase in proportion to the consumption of coals, which would proceed at the rate of about 44 tons per day. The duration of the voyage, reckoning upon a uniform velocity, would be about $7\frac{1}{4}$ days.

I shall conclude this lengthy communication by stating, that such a system of engines as I have referred to is known. And I trust it is not presumptuous to suppose that steamers might be provided with boilers so constructed as to weigh proportionately less than those now in general use; besides being safer, producing steam at a less expense of fuel, relieving the stokers from a great portion of their labour, and protecting them more effectually from the heat.

If I have not already trespassed too much on the space of your valuable *Journal*, I shall return to this subject on some future occasion.

Manchester. R. B.

ON THE EFFECT OF PRESSURE IN LOWERING THE FREEZING-POINT OF WATER EXPERIMENTALLY DEMONSTRATED.

By Professor W. Thomson, Glasgow.*

In Mr. James Thomson's paper, "Theoretical Considerations on the Effect of Pressure in Lowering the Freezing Point of Water," it was demonstrated that, if the fundamental axiom of Carnot's Theory of the motive power of heat be admitted, it follows, as a rigorous consequence, that the temperature at which ice melts will be lowered by the application of pressure; and the extent of this effect due to a given amount of pressure was deduced by a reasoning analogous to that of Carnot from Regnault's experimental determination of the latent heat, and the pressure of saturated aqueous vapour at various temperatures differing very little from the ordinary freezing-point of water. Reducing to Fahrenheit's scale the final result of the paper, we find

$$t = n \times 0{\cdot}0135;$$

where t denotes the depression in the temperature of melting ice produced by the addition of n "atmospheres" (or n times the pressure due to 29·922 inches of mercury), to the ordinary pressure experienced from the atmosphere.

In this very remarkable speculation, an entirely novel physical phenomenon was *predicted* in anticipation of any direct experiments on the subject; and the actual observation of the phenomenon was pointed out as a highly interesting object for experimental research.

To test the phenomenon by experiment without applying excessively great pressure, a very sensitive thermometer would be required, since for ten atmospheres the effect expected is little more than the tenth part of a Fahrenheit degree; and the thermometer employed, if founded on the expansion of a liquid in a glass bulb and tube, must be protected from the pressure of the liquid, which, if acting on it, would produce a deformation, or at least a compression of the glass that would materially effect the indications. For a thermometer of extreme sensibility, mercury does not appear to be a convenient liquid; since, if a very fine tube be employed, there is some uncertainty in the indications on account of the irregularity of capillary action, due probably to superficial impurities, and observable even when the best mercury that can be prepared is made use of; and again, if a very large bulb be employed, the weight of the mercury causes a deformation which will produce a very marked difference in the position of the head of the column in the tube, according to the manner in which the glass is supported, and may therefore affect with uncertainty the indications of the instrument. The former objection does not apply to the use of any fluid which perfectly wets the glass; and the last-mentioned source of uncertainty will be much less for any lighter liquid than mercury, of equal or greater expansibility by heat. Now the coefficient of expansion of sulphuric ether, at 0° C., being, according to M. I. Pierre,† ·00151, is eight or nine times that of mercury (which is ·000179, according to Regnault); and its density is about the twentieth part of the density of mercury. Hence a thermometer of much higher sensibility may be constructed with ether than with mercury, without experiencing inconvenience from the circumstances which have been alluded to. An ether thermometer was accordingly constructed by Mr. Robert Mansell of Glasgow, for the experiment which I proposed to make. The bulb of this instrument is nearly cylindrical, and is about $3\frac{1}{2}$ inches long and $\frac{3}{8}$th of an inch in diameter. The tube has a cylindrical bore about $6\frac{1}{2}$ inches long: about $5\frac{1}{2}$ inches of the tube are divided into 220 equal parts. The thermometer is entirely enclosed, and hermetically scaled in a glass tube, which is just large enough to admit it freely.

* To such of our readers as have perused Mr. James Thomson's paper, "Theoretical Considerations on the Effect of Pressure in Lowering the Freezing-Point of Water," at page 9 of our last number, the present article will require no introduction.—Ed. P. M. Journal.

† See Dixon on Heat, p. 72.

On comparing the indications of this instrument with those of a thermometer of Crichton's with an ivory scale, which has divisions, corresponding to degrees Fahrenheit, about $\frac{1}{25}$th of an inch each, I found that the range of the ether thermometer is about 3° Fahrenheit, and that there are about 212 divisions on the tube corresponding to the interval of pressure from 31° to 34°, as nearly as I could discover from such an unsatisfactory standard of reference. This gives $\frac{1}{71}$ of a degree for the mean value of a division. From a rough calibration of the tube which was made, I am convinced that the values of the divisions at no part of the tube differ by more than $\frac{1}{30}$th of this amount, from the true mean value; and, taking into account all the sources of uncertainty, I think it probable that each of the divisions on the tube of the ether thermometer corresponds to something between $\frac{1}{68}$ and $\frac{1}{75}$ of a degree Fahrenheit.

With this thermometer in its glass envelope, and with a strong glass cylinder (Œrsted's apparatus for the compression of water), an experiment was made in the following manner:—

The compression vessel was partly filled with pieces of clean ice, and water: a glass tube about a foot long and $\frac{1}{10}$th of an inch internal diameter, closed at one end, was inserted with its open end downwards, to indicate the fluid pressure by the compression of the air which it contained: and the ether thermometer was let down and allowed to rest with the lower end of its glass envelope pressing on the bottom of the vessel. A lead ring was let down so as to keep free from ice the water in the compression cylinder round that part of the thermometer tube where readings were expected. More ice was added above, so that both above and below the clear space, which was only about two inches deep, the compression cylinder was full of pieces of ice. Water was then poured in by a tube with a stopcock fitted in the neck of the vessel, till the vessel was full up to the piston, after which the stopcock was shut.

After it was observed that the column of ether in the thermometer stood at about 67°, with reference to the divisions on the tube, a pressure of from 12 to 15 atmospheres was applied, by forcing the piston down with the screw. Immediately the column of ether descended very rapidly, and in a very few minutes it was below 61°. The pressure was then suddenly removed, and immediately the column in the thermometer began to rise rapidly. Several times pressure was again suddenly applied, and again suddenly removed, and the effects upon the thermometer were most marked.

The fact that the freezing-point of water is sensibly lowered by a few atmospheres of pressure, was thus established beyond all doubt. After that, I attempted, in a more deliberate experiment, to determine as accurately as my means of observation allowed me to do, the actual extent to which the temperature of freezing is affected by determinate applications of pressure.

In the present communication, I shall merely mention the results obtained, without entering at all upon the details of the experiment.

I found that a pressure of, as nearly as I have been able to estimate it, 8·1 atmospheres produced a depression measured by 7½ divisions of the tube, on the column of ether in the thermometer; and again, a pressure of 16·8 atmospheres produced a thermometric depression of 16½ divisions. Hence the observed lowering of temperature was $\frac{7\frac{1}{2}}{71}$, or ·106° F. in the former case, and $\frac{16\frac{1}{2}}{71}$, or ·232° F. in the latter.

Let us compare these results with theory. According to the conclusions arrived at by my brother in the paper referred to above, the lowering of the freezing-point of water by 8·1 atmospheres of pressure would be 8·1 × ·0135, or ·109° F.; and the lowering of the freezing-point by 16·8 atmospheres would be 16·8 × ·0135, or ·227° F. Hence, we have the following highly satisfactory comparison, for the two cases, between the experiment and theory.

Observed Pressures.	Observed Depressions of Temperatures.	Depressions according to Theory, on the hypothesis that the Pressures were truly observed.	Differences.
8·1 Atmospheres.	·106° F.	·109° F.	— ·003° F.
16.8 Atmospheres.	·232° F.	·227° F.	+ ·005° F.

It was, I confess, with some surprise, that, after having completed the observations, under an impression that they presented great discrepancies from the theoretical expectations, I found the numbers I had noted down indicated in reality an agreement so remarkably close, that I could not but attribute it in some degree to chance, when I reflected on the very rude manner in which the quantitative parts of the experiment (especially the measurement of the pressure, and the evaluation of the division of the ether thermometer) had been conducted.

I hope, before long, to have a thermometer constructed, which shall be at least three times as sensitive as the ether thermometer I have used hitherto; and I expect with it to be able to perceive the effect of increasing or diminishing the pressure by less than an atmosphere, in lowering or elevating the freezing point of water.

If a convenient *minimum* thermometer could be constructed, the effects of very great pressures might easily be tested by hermetically sealing the thermometer in a strong glass, or in a metal tube, and putting it into a mixture of ice and water, in a strong metal vessel, in which an enormous pressure might be produced by the forcing-pump of a Bramah's press.

In conclusion, it may be remarked, that the same theory which pointed out the remarkable effect of pressure on the freezing-point of water, now established by experiment, indicates that a corresponding effect may be expected for all liquids which expand in freezing; that a reverse effect, or an elevation of the freezing-point by an increase of pressure, may be expected for all liquids which contract in freezing; and that the extent of the effect to be expected may, in every case, be deduced from Regnault's observations on vapour (provided that the freezing-point is within the temperature-limits of his observations), if the latent heat of a cubic foot of the liquid, and the alteration of its volume in freezing be known.

THE EXPERIMENTAL SQUADRON OF FRIGATES.

[The following particulars of the doings of the Government Experimental Squadron, are by an old correspondent of our own, who has frequently added to the interest of the pages of this Journal]:—

The squadron of war frigates, now, and for some time back, out on an experimental cruise, consists of the *Phaeton*, by Joseph White; the *Leander*, by Mr. Blake; *Arethusa*, by Sir William Symonds; *Indefatigable*, by Edye—all 50-gun frigates. There is, besides, the *Retribution*, paddle steam frigate, with engines of 400-horse power, by Penn, (her former ones of 800 were by Maudslay, and were too large and heavy, having flue boilers); she carries 28 guns. The *Dauntless*, 24 guns, and *Arrogant*, 46, both by Fincham; and also the *Encounter*, 14, of similar parentage. All the 50-gun frigates have rising floors, the principal differences in their midship sections being near the water line. *Phaeton's* rise terminates a little below the water; *Leander's* more so still; while *Arethusa's* is continued a few inches above the water, so that her greatest breadth is considerably above water, and her topsides tumble home a good deal—the others being more or less wall-sided; *Phaeton* most so. The *Phaeton* has a long bow, and a very upright stem; she is between three and four feet longer than the other vessels, and the extra length appears to be all in the bow. *Leander's* bow is what is called Blake's—that is to say, it falls out above, like a steamer's, so as to give the forepart of the deck a great breadth, while it is tolerably fine below for speed. The object of the great breadth above is to make room for guns, of which she can fire six straight a-head; the two on the main deck may even be made to cross their lines of fire under the bowsprit. The principal peculiarity of the *Arethusa* is, that she carries no ballast, which is certainly a great advantage, as it leaves displacement available for useful stores. She is very stiff under canvas, and very easy at sea, being the only ship that did not require any caulking after the last cruise, the latter part of which exposed the ships to a hard gale of wind for ten days. No doubt, the absence of ballast contributed very materially to this result, as no other weight that could be carried in the shape of stores and water, &c., could be stowed in such small bulk as iron ballast, and consequently the weight would be diffused over the whole frame of the ship, instead of being concentrated in a small part of her bottom. The *Arethusa*, however, pitches rather deep, which is a common vice of Symonds' ships. I presume you know pretty well what the *Dauntless* is, as she was somewhere about two years in the Clyde; it may therefore suffice to say, she is a frigate, very long, flat-bottomed, with a not particularly handsome bow, as all the water-lines are full, down to the very bottom; and the stern being nearly upright, her forefoot is very thick, and looks clumsy in dock. Her run is very clean, her stern having been altered. She is propelled by the screw, with engines of 580 nominal horse power, by Robert Napier. Her displacement is nearly equal to that of the *Leander;* but owing to her want of breadth, her masts and sails are less, the canvas being about three-fourths of that of the 50's. The *Arrogant* is as well known as any of the ships; she has an auxiliary screw of 360 horse power, by Penn, and is full rigged. She is a remarkably fine ship.

In the last cruise, the *Phaeton* was decidedly the fastest ship, and the most weatherly. The *Arethusa* next, then *Leander* and *Arrogant* about equal—*Arrogant* rather the first. *Dauntless* generally last, but occasionally beat the two last-named, particularly in heavy weather, and more in fore-reaching than in going to windward. The screws of the steam-ships are always lifted out of water when sailing. In sailing

with the wind free, the order was generally—*Phaeton* first, then *Arethusa* and *Dauntless* equal, then *Arrogant* and *Leander* last. The last trial with the *Phaeton* was very interesting, and would have been much more so, but for an unfortunate accident to that ship. The wind was on the bow, and signal being made to chase, the *Arethusa* and *Arrogant* came down from the weather line into the lee one, for a start. It was blowing very hard, with a heavy sea, and occasional squalls. The ships were under treble reefs. All except the *Dauntless* shook out two reefs, and the pace was about 8 or 9 knots, close-hauled, and the excitement proportional. The *Arrogant* and *Leander* were soon dropped, and the race was between the other three, whose positions were—*Dauntless* first, *Arethusa* about ½ mile behind, and *Phaeton* between the two, but to leeward. *Phaeton* was gaining fast; but being so near *Dauntless*, could not get to windward; so she signalized to *Dauntless* to keep her wind, hoping, I suppose, to induce her to luff and let her pass; however, it did not take. In the meantime, *Arethusa* found she was not gaining, so she came up on *Dauntless'* lee quarter, hoping to make up by forereaching, and get to windward if possible afterwards; but she went so much to leeward, that she was obliged to resume her course, by which, of course, she fell astern. She now, however, set top-gallant sails, by the help of which she soon came up to windward of *Dauntless*, and she and *Phaeton* were each on one bow of *Dauntless*, the *Phaeton* just thinking of stretching across, when a glorious tug would have ensued between her and *Arethusa*—when down came a tremendous squall, to which *Arethusa* let fly her top-gallant sheets, and saved everything—*Dauntless* held on everything, but had her jib split; while *Phaeton* lost her jibboom, and carried away her weather main and lee fore topsail sheets; in fact, was a complete wreck for the time. The worst of it was, that the trial was stopped, not having lasted 4 hours. *Phaeton* was sent to England, as she signalized her foremast sprung, and other damages. Both *Phaeton* and *Arethusa* were very stiff, and all the ships very easy; the *Arethusa* could have fought her lee guns all the time. One thing is very peculiar in the *Phaeton's* behaviour against a head sea—whenever she gets on the top of a sea, so that a good part of her bow is out of water, she seems to spring suddenly forward without pitching more than a little. Various accounts have been published of the above trial, which happened on 19th Nov.; but all that I have seen have come evidently from interested parties, and all more or less exaggerated; but after comparing notes with several whom I consider candid judges, I feel satisfied that the above is correct. There is a great deal of *yacht* feeling among the crews of the ships, and they are often led into undue partiality for their respective ships, which, however beneficial in stimulating them to get the very best performance out of their ship, is not favourable to the cultivation of calm and unprejudiced judgment.

The Peninsular and Oriental mail packets on this line have been very unfortunate lately. The *Montrose* broke an air-pump, crosshead, and rod, and the *Jupiter* broke a paddle-shaft; it was repaired at *Corunna*, by means of a large cast-iron coupling applied round the shaft in two pieces; the fracture was between the inner and middle paddle-centres, but nearer the middle one. Stays were added between the flanges, and the job appeared a very substantial one. Commodore Martin sent all the engineers in the fleet to see it, and after the ship had left the port, he sent for sketches and descriptions, with opinions, as to the sufficiency of the repairs. I understand he was very well pleased, and he is not so incapable of judging as you might suppose, being well up in steam books, and he is an uncommon 'cute fellow in his own profession.

The *Dauntless* and *Arrogant* had two (steaming) trials at sea against each other. Against a strong head wind and heavy sea, *Dauntless* went 4.1 and *Arrogant* 3.8 knots; and before the wind, with sail set, not much of it, *Dauntless* 10.1 and *Arrogant* about 9. *Dauntless* does not steam well, and cannot therefore exert the power that her valve pressure would enable the engines to expend upon her. Her distinguishing features as a steamship are—full power as compared to tonnage; flat floor and light draft of water, and screw of coarse pitch. Those of the *Arrogant* are quite the contrary—auxiliary proportion of power; sharp floor and deep draft of water; fine pitched screw, which is also of much larger diameter in proportion to power than that of *Dauntless*. The form of *Arrogant's* after body is also contrasted with that of *Dauntless*; she has the original square tuck in nearly all its perfection; the corners being merely rounded off as much as possible—the effect of this form is to preclude high speed altogether; but it is questionable whether it is not advantageous for such low speeds (say up to seven knots) as auxiliary power is equal to, in which the form of the ship is not of so much importance, as when under sail there is a following current produced in the water which gives the screw an abutment to work against, that sometimes is found very effective. It is said, and on good authority, that even without sail the screw has several times exhibited negative slip, and the *Arrogan* has been an instance. But I have never been able to ascertain that the vessels in which this phenomenon has been observed, on experimental trials, ever were in the constant habit of working under such circumstances; it seems to have been only an occasional occurrence, and if so, it must have been the result of some unobserved accidental circumstance, and not of form, full or fine. The only supposition that will account for it, is that of the water not moving so fast (relatively to the ship) in the immediate neighbourhood of the screw as at other parts of the ship; that is, it was partially dragged after the ship, to fill up the vacuum formed by her forward progress. But in order to produce this current, by which the screw is to benefit so much, power must be employed, that is, of course, engine-power; yet, if my memory serves me rightly, the speed of the ship has been always as much as what was due to the power employed. There is, therefore, a mystery about this negative slip, if our information stops here; but I would fain hope that some one well versed in the laws of the motion of fluids, will yet find a satisfactory solution of this difficulty.

The Portuguese are going to send a model of the *Vasco de Gama*, their 80-gun ship, to the great Exhibition. This ship has a considerable reputation for sailing, and carrying and stowing well also—she is now dismantled in the Tagus, having lately returned from Brazil. I have been told, I know not with how much truth, that Nelson offered the Portuguese an English ship, complete for sea, for her; and also, that the Government have refused considerable offers for her lines from our Admiralty. I hear that the other articles sent from hence to the Exhibition, will consist principally of specimens of marble, salt, and stone, with tiles like Dutch tiles, which are extensively used for covering the walls of houses, both internally and externally. I have been told that they have some remarkably strong mortar, like the old Roman mortar, the peculiar qualities of which are attributable to the lime of which it is made. I should say, however, that the Lusitanian stall in the great show will not be specially attractive, for the arts are in a very low state, and there is an air of poverty pervading the place.

The squadron is going to sea for another cruise in a day or two, when all the ships mentioned at the beginning of this letter will go, with the exception of the *Arrogant* and *Encounter*. The former has had an accident to her machinery, a clutch coupling on the screw shaft having lost one of its teeth; it is undergoing repair, by replacing one of the halves of the clutch, which is being cast at Peter's Phœnix Foundry here.

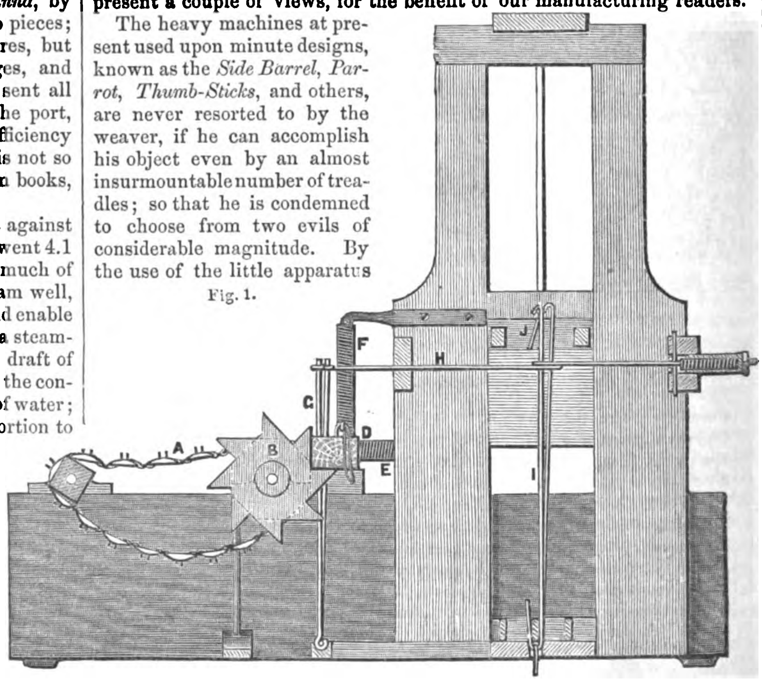
Lisbon, Feb. 24*th*, 1851.

IMPROVEMENTS IN JACQUARD MECHANISM.
SMITH'S SPELF MACHINE.

Mr. James Smith, of Galston, Ayrshire, has contributed to the Exhibition a model of what he terms his "Spelf Machine,"—of which we present a couple of views, for the benefit of our manufacturing readers.

The heavy machines at present used upon minute designs, known as the *Side Barrel*, *Parrot*, *Thumb-Sticks*, and others, are never resorted to by the weaver, if he can accomplish his object even by an almost insurmountable number of treadles; so that he is condemned to choose from two evils of considerable magnitude. By the use of the little apparatus

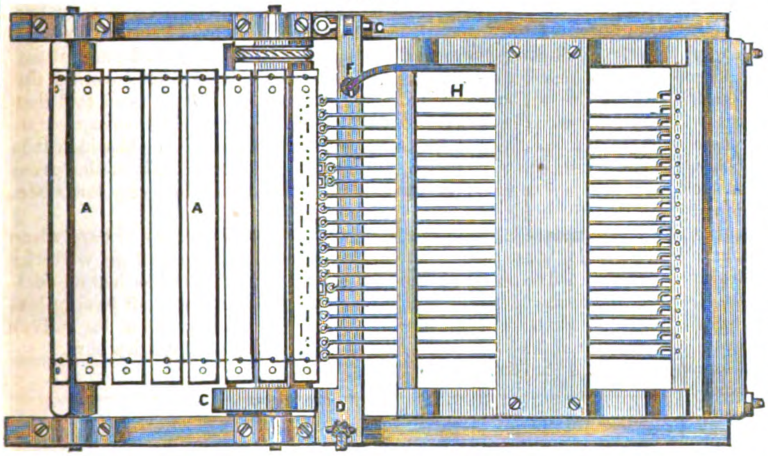
Fig. 1.



now before us. Mr. Smith has been enabled to overcome both objec-

tions. As an example of its application, a species of scarf-work, extensively manufactured for the foreign market, may be mentioned. This class of fabric ordinarily involves a most troublesome process; but with the assistance of the "Spelf Machine," it is worked as easily as plain *Jaconnet*. It has also been adapted to work in conjunction with the Jacquard machine, having been used in working the body of the handkerchief, whilst the Jacquard only produced the cross border. On its first introduction, the apparatus was known as the *Treadle* machine, from the part it performed as a substitute for that class of gearing; but the spelfs being brought into extensive use, as an improvement upon all kinds of barrel-weaving, the latter term was chosen as the distinguishing name. Fig. 1 of our engravings represents a side elevation of the machine, and fig. 2 is a corresponding plan. The spelfs, A, which may be increased or diminished in number, according to the extent of pattern, are strung together in an endless chain, and made to pass over a barrel, B, of octagonal section—having an eight-toothed ratchet-wheel, C, on one end, each tooth corresponding to a plane on the barrel. The barrel is driven round through this ratchet by a lever, which being elevated to turn slightly on its fixed centre at one end, the horizontal helix, E, throws it upon the succeeding tooth of the wheel; whilst the vertical helix, F, brings the lever down to its stop, thus carrying round the ratchet-wheel and barrel, and bringing the next spelf forward. The pattern is read upon the spelfs by wire stapling, and as each comes into action, the staples press against the vertical wires, D. This movement actuates the horizontal needles, H, and thus forces such of the needles of the row, I, as are not required to be raised, off the draught knife, J, leaving the rest to be elevated. This forms a draught of the figure, either with *leaves* or *harness*, as the case may be.

Fig. 2.



The machine is placed in the centre, on the top frame of the loom, and the draught lever is also attached to this frame, working in a bolt, reaching from the centre of the loom, where it is attached to the machine—to the side—where it is also fixed to the points of the long levers of the loom. As the draught lever works over the spelf, the cylinder lever may be attached to it when it suits. But if two or more shots of weft are to be thrown for each spelf, then a small lever is provided to raise it at pleasure.

THE MECHANIC'S LIBRARY.

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Temperature of the Seasons, fcp. 3s. cloth. Dr. J. Fleming.

RECENT PATENTS.

PNEUMATIC SPRINGS, BUFFERS, PUMPS, AND STUFFING-BOXES.

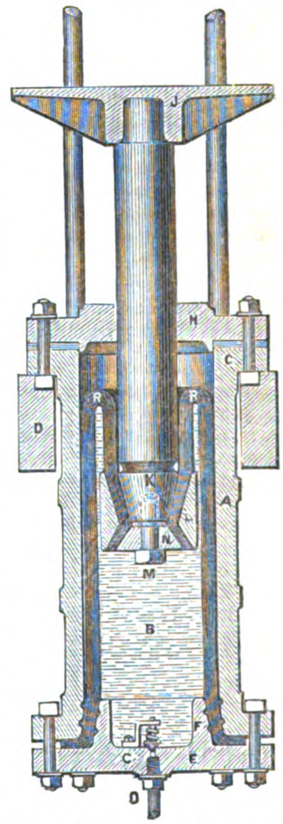
JULIAN BERNARD, ESQ., *London.—Enrolled, April* 4, 1851.

This invention consists essentially of a most ingenious application of flexible tubes or cylinders, as substitutes for the ordinary cylinder and piston of pumps—the springs of buffers, and as affording a simple and effective species of stuffing-box for various purposes. The principle embodied in Mr. Bernard's adaptation of the flexible material may be shortly described as the causing one end of the tube to turn or fold in or over the remaining portion, which, for the time being, forms the receptacle for the fluid to be transmitted—in the case of a pump—or for the air used as the elastic medium, in a buffer. This system of turning in the tube, gives peculiar facilities for the expansion or contraction of the space enclosed by the tube, whilst it is very favourable to the durability of the material under the effects of wear. One of the most important purposes to which the patentee applies his plan, is the production of a cheap and easily manageable pressure apparatus, to take the place of the cylinder and ram of the common hydrostatic press.

Fig. 1 of our engravings represents a vertical, longitudinal section of a portion of a hydrostatic press, as fitted up according to this arrangement.

The metal cylinder, A, which, with its internal flexible cylinder or tube, B, is in this application substituted for the ordinary hydrostatic cylinder, is cast open at both ends, and rests by an upper flange, C, upon the girders or beams, D D, forming the base of the press. The bottom of the cylinder, which is formed with a slight internal cone, is closed by a flanged end, E, cast with a projecting cone, F, and bolted on to the cylinder by its flanges. The projecting cone, F, enters the cylinder end, and has grooves turned on its exterior surface. The flexible cylinder or tube, B, which may be made of caoutchouc, or gutta percha, combined, or not, with any stout fabric as a body, is of about the same diameter as the bore of the external metal cylinder, A, and its lower end is held down to the end of the cylinder, A, by being interposed between the exterior surface of the cone, F, and flange of the end, E, and the interior, or corresponding portion of the cylinder, A. Thus, when the end is so interposed, the pressure of the cone, F, when forced in close contact with the cylinder, causes the flexible material to be firmly held down, the grooved surface of the cone having the effect of biting into it, and this effect is further assisted by forming similar holding grooves in the interior of the cylinder end. The upper end of the cylinder, A, is closed in by a flanged cover, H, bored out to admit the ram, I, through which the power derived from forcing water into the cylinder, is transmitted to the moveable pressing table, J. It is to the end of this ram that the upper or opposite end of the flexible tube, B, is attached. The conical end, K, of the ram, being entered into the end of the flexible tube, the ferule, or ring, L, which is bored out conically, is passed over the tube encircling the ram, and is forced to a hard bearing to squeeze the end of the tube upon the ram by the set-screw, M. This screw is tapped into the end of the ram, and is passed through the small conical washer, N. When the screw is driven home, it forces the conical periphery of the washer, N, hard up against the interior of the end of the flexible tube, which is thus held against the corresponding narrow interior conical surface, formed on the lower end of the ferule, L. To insure still greater security of connection, the end of the ram, and the interior of the ferule, L, may be grooved, as described

Fig. 1.

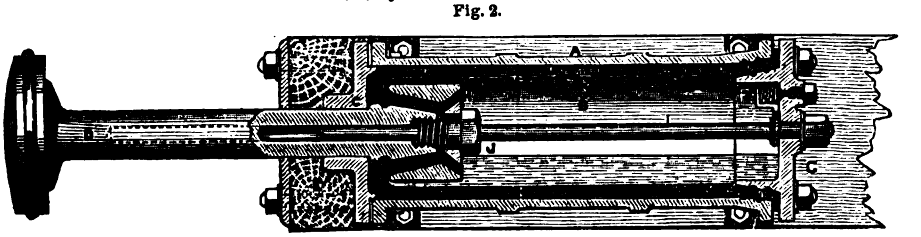


in reference to the bottom end of the cylinder. In fitting up this apparatus, the ram is first passed through the flexible tube to the end, and the attachment being made as already described, the loose end of the tube is turned back over the fastened end on the ram, thus turning the tube inside out. The loose end of the tube so turned over, is then attached to the bottom of the cylinder, A, by screwing on the coned end.

The force-pump supplying the pressure cylinder with water is in communication with the pipe, O, shown broken away. This pipe has a screw coupling on its end, by which it is connected to the bottom of the cylinder, A. The water enters into the interior of the flexible tube, B, by the small bore, P, which is guarded by a conical valve, Q, held down by a slight spring. The external metal cylinder, A, answers simply as a guide or retainer for the internal flexible tube, B, which receives the actuating water. Thus, when water is forced in by the pump, the internal pressure so obtained, acts against the end of the ram, and, distending the flexible tube, causes it to unfold, by the combined pressure upon the ram, and the annular part, R R, of the tube, whilst the ram, I, rises and elevates the table, J. The injected fluid is discharged from the tube by a suitable valve placed in the bottom of the cylinder. In this arrangement of a hydrostatic press, the greatest portion of the friction arising in an ordinary press, is avoided, the only frictional resistance in the working of the cylinder, being that due to the bending and gradual unfolding of the flexible tube, and the sliding of the ram through the cylinder cover. Similarly, leakage is entirely prevented, as the injected fluid is retained within the flexible tube, and is not in contact with any sliding joint—the flexible tube itself acting as the stuffing-box of the ram.

Our second illustration, fig. 2, exhibits the flexible tube as applied in a railway-buffer—the cylinder being in longitudinal section, as delineated in this figure, the buffer is supposed to be at the extremity of its outward travel, as the common buffer would be when not screwed up. The details of the external metal cylinder, A, and the flexible tube, B, are similar to the same parts described in reference to the hydrostatic press. The front cover, C, of the cylinder, A, through which the buffer rod, D, projects, is recessed or sunk into the inner face of the buffer beam, E, of the carriage or waggon to which it is attached. In setting this buffer in action, the buffer is pushed quite home, so as to turn inwards the end of the flexible tube, B, to its fullest extent, the air in the tube being allowed to escape, either by keeping open the small valve, F, in the cylinder bottom or end cover, G, or by performing this part of the operation before the cover is bolted on. When this is done, as much water or other liquid is poured into the tube, B, as will fill up the entire annular space which is left filled with air. The buffer is then again drawn out to the position shown, allowing atmospheric air to enter the tube, B, as it expands and fills up the remaining space. The buffer is thus ready for use, the air enclosed in the tube, B, acting as the elastic medium for receiving the shocks given to the buffer, as when the latter is forced inwards, the traverse of its rod, D, turns inward the end, H, of the tube, and contracts the air space. As a guide and support for the buffer rod, a spindle, I, is bolted into the centre of the cover, so as to stand directly in the axial line of the cylinder, and projecting far enough to reach the front cover. The set-screw, J, by means of which the tube is

Fig. 2.



attached to the end of the buffer rod, is bored out to admit the end of the guide-spindle to pass through it, and enter the buffer rod, which is also bored out, or made tubular to receive it. In this way, the buffer rod has a continuous guide throughout its stroke. The object of introducing a fluid to the tube, B, is to provide a stop for the inner end of the buffer rod, as, from the incompressible nature of liquids, the buffer, under such circumstances, can never be driven home so as to come in contact with the bottom end of the cylinder. When the buffer is prepared for use in this manner, it is obvious that the flexible tube will contain air at the ordinary atmospheric pressure, but, if necessary, a considerable initial pressure, or resisting power, may be given to the buffer by forcing in either air or a fluid, to a certain extent, by the small inlet valve.

Flexible tubes, turned inwards in this manner, are plainly applicable, when fitted with proper inlet and discharge valves, as air or water pumps, the tubes being either enclosed or left uncovered. When used as air pumps, water may be admitted into the tubes for the purpose of displacing any air contained therein, so that, in action, the pump will expel at each stroke the entire supply of air previously taken in. This ingenious plan is obviously applicable to a great variety of purposes, and offers many advantages, as an air or fluid-tight connection between many parts of mechanism.

HYDRAULIC CLOCKS.

C. T. TIFFERAU, *Paris.—Enrolled April* 3, 1851.

In Mr. Peppé's mercurial time-keeper, we some time ago* furnished an example of an apparent resuscitation of the principle of the *Clepsydra* of ancient days. In M. Tifferau's later invention we find a still closer approximation to this class of horologes; for in it the actual descent of water counts the hours, and marks the course of time. The patentee gives two examples of his clocks. In the first, the passage of the hours is indicated by the fall of the water level in a vessel, from which the fluid is gradually discharged by a syphon. Fig 1 of our engravings represents an external elevation of this clock. Fig. 2 is a corresponding vertical section. Three cylinders, A B C, are mounted one upon the other.

Fig. 1.

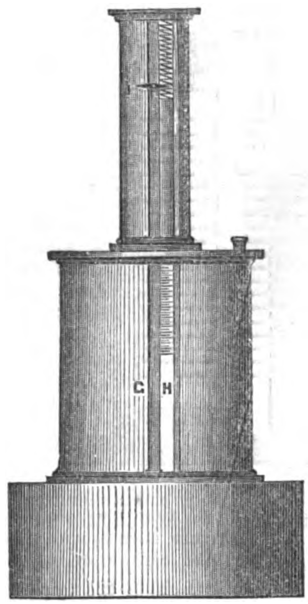
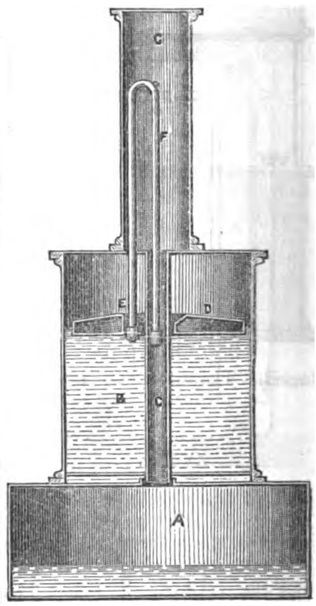


Fig. 2.



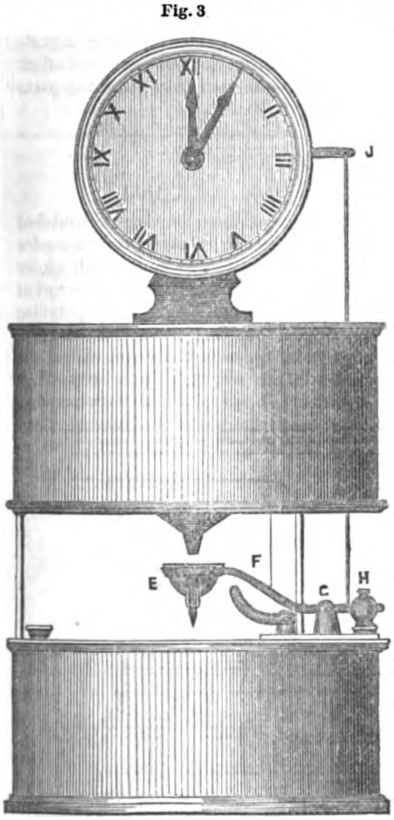
1-6th.

forming a short pedestal, resembling a lamp. The cylinder, A, forms the base of the clock, and upon it is placed the intermediate chamber, B, to hold the water used as the measuring medium. This chamber is closed at top and bottom, and through its centre is passed a wide tube, C′, open at both ends, its lower end being in communication with the bottom chamber, A. A hollow circular float, D, in the chamber, B, having a central hole to allow it to move up and down upon the tube, C′, has attached to it, at E, the shorter arm of a syphon, F, used to discharge the water from the chamber, B, into the base, A. The longer arm of the syphon passes down the open tube, C′, in which it can work freely without contact with the sides. Each arm of the syphon carries, and opens into, a small cup, perforated with minute apertures for the passage of the water. The syphon is set at work in the usual manner, and discharges water from the chamber, B, through its longer arm into the chamber beneath. As the water level in the float chamber falls, the descent of the float carries the syphon down with it, and thus the water is discharged through it at a perfectly uniform rate. The external vertical glass tube, G, opening into the bottom of the chamber, B, affords the means of observing the fall of water in the chamber. When the clock is started, the upper cylinder, C, which is simply a cover for the syphon, and is connected to the cover of the chamber, B, is placed in position, the water chamber being filled up at the same time. The difference between

* Page 189, vol. III.

the influx and efflux water levels of the syphon being always the same, the flow is constant and uniform. The rate is adjusted either by raising up the bowl at the end of the long arm of the syphon, or by causing the short arm to dip further into the water in the chamber. By this alteration the difference of level is diminished, and the flow consequently decreased. When the proper regulation has been accomplished, the scale, H, of the glass tube, A, is graduated to correspond.

Fig. 3



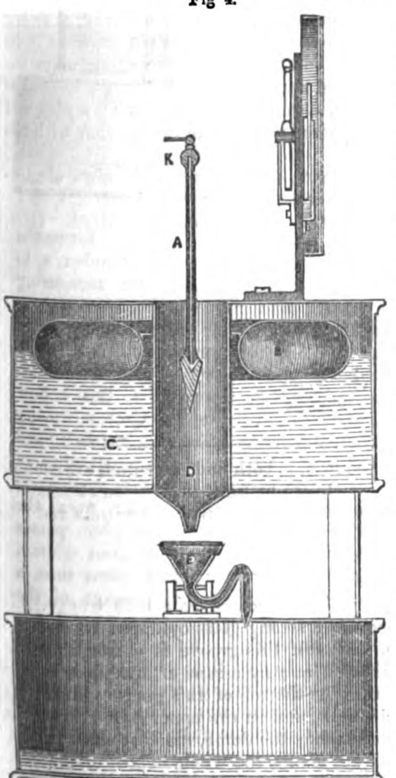
1-4th.

The time may also be indicated by attaching an index, I, to the top of the syphon, to command a graduated scale on the cover, C. Or a still simpler mode is to graduate one of the syphon arms, and read the time from the level of the cover of the chamber, B.

To wind up the clock, the chamber, B, is removed, and the water run into the base, A, is poured back into the chamber, B, by the aperture, J, until the time at which the winding-up took place, as indicated on the lower end of the scale, H, is similarly indicated at the upper portion. The chamber, B, is then replaced. The water run out during the operation of winding must now be added, and this gives the exact time which has elapsed during the operation.

Instead of a vertical scale, the time may be marked upon a common circular dial, carried on the chamber, B, a revolving index being turned by the vertical movement of the syphon.

Fig 4.



1-4th.

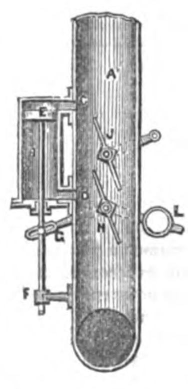
Fig. 3 of the engravings represents a front elevation of another plan, in which the fall of water impels an arrangement of mechanism, pointing out the time on a common clock dial. Fig. 4 is a corresponding vertical section of the clock, taken at right angles to fig. 3. The action of the syphon, A, and float, B, contained in the chamber, C, is in this case similar to that of the corresponding parts in the clock first described. The water is gradually run off by the fallen syphon, and descends through the mouth of the tube, D, into the cup, E, of the lever, F. This lever is free to oscillate on the centre, G, its opposite short end being counterpoised by a weight, H. As the water descends drop by drop into the cup, E, its gradually accumulating weight at length bears down the cup, and with it the small syphon, I, into which the conical bottom of the cup opens. The cup then remains in its depressed position until the syphon, being filled to its upper bend, commences to run the water off from the cup, and the latter being lightened, returns to its normal position. This motion of the lever, F, is conveyed to the upper lever, J, actuating the dial apparatus by suitable ratchets, which work the pointers. To regulate the action of the syphon, A, a stop-cock, K, is fitted in its upper bend, the opening or closing of which correspondingly adjusts the flow. The winding up of this clock is a very simple matter, as nothing more is necessary than to fill up the chamber, C, with water from time to time.

It is obvious that apparatus of this kind is applicable for measuring, comparing, or graduating the contents of vessels of all kinds.

STEAM-ENGINES.

ROBERT WADDELL, *Liverpool.—Enrolled December* 11, 1850

Mr. Waddell's invention embraces two points of improvement—the first of which is an arrangement for the removal of water from steam-engine cylinders, by means of a loaded valve, which opens to admit of the discharge of the fluid, by the action of the gravity of the accumulated fluid itself. During the ordinary working of the engine, this discharge valve is unacted on by the steam pressure; but on water making its appearance in the cylinder, it flows into the small chamber containing the discharge valve, and the weight thus brought to bear upon the valve causes the latter to open. The second point has reference to a peculiarly ingenious plan for the regulation of the speed of the engine. Our engraving represents the arrangement, as fitted on the supply steam pipe, A, shown in longitudinal section. To the side of the steam pipe is attached a small cylinder, B, having top and bottom ports, C D, opening into the pipe, A. The cylinder is bored to receive a piston, E, the rod of which passes through a stuffing-box in one end of the cylinder, and is guided vertically at F. This rod carries a small pin, which fits to a slot in the end of a short lever, G, fast on the spindle of the throttle valve, H, a weighted lever, I, being carried on the opposite side of the same spindle, to balance the weight of the piston and its adjuncts. The usual throttle valve is placed at J, a little above the valve H, or between the latter and the boiler. Our figure represents the apparatus as it would be during the regular action of the engine. Steam from the main pipe enters the cylinder at both ends, and the pressure on each side of the piston being the same, the latter stands at one fixed point. Should the engine accidentally run off at an unduly high rate, the rapid motion will cause the steam in the pipe to be more or less "wire-drawn" or attenuated, and the pressure will thus be greater on the side of the throttle valves next the boiler than on the other. This superior pressure, then, acting on the upper side of the piston, E, presses it downwards, and thus partially closes the second throttle valve, H, and reduces the supply of steam to the cylinder. So soon as the engine regains its proper rate, the pressure in the cylinder, B, is equalized on each side of the piston, when the counterweight, I, will bring back the valve to its original position.



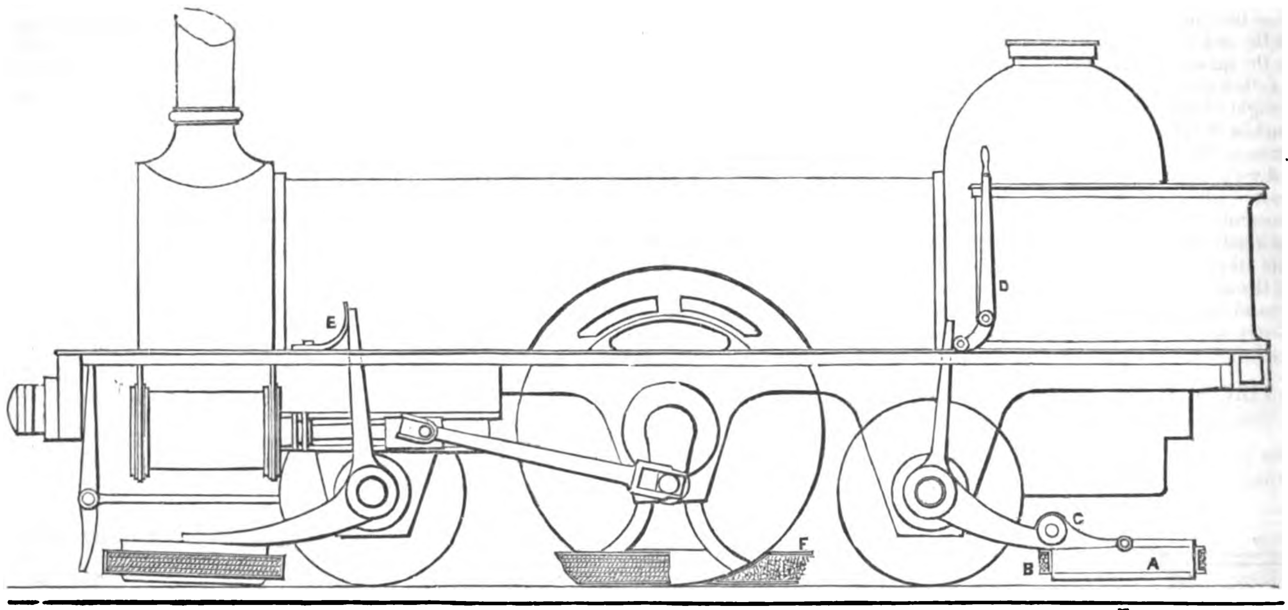
ELECTRO-BRAKES, AND ELECTRO-MOTIVE AND ADHESION APPARATUS FOR RAILWAY CARRIAGES.

J. P P. AMBERGER, C.E., *Paris.—Enrolled April* 3, 1851.

M. Amberger has struck out some novel branches of employment for electro-magnetism. In setting this power to work as a brake or velocity-regulator for railway purposes, he places his "electro-brakes" on the engine or carriages of a train, in such a position, that when the electric current is put in force upon them, they will come forcibly in contact with the rails, producing the frictional results of ordinary brakes. Fig. 1 of our engravings exhibits a longitudinal elevation of a locomotive engine fitted with brakes of this species. They are composed of rectangular masses of iron, A, in shape like a segment of a wheel rim, and are encased in a copper covering, B, carrying the wires of the battery. The illustration, fig. 1, details two modifications of arrangement. The one at the fire-box end of the engine, the copper case of which is delineated in section, together with its coils of wire, is hinged at C, with a stop-joint to one arm of a double lever which turns upon the end of the hind axle as a centre. The upper lever-arm projects a short distance above the

engine-driver's foot-plate, and bears against the curved lower end of a hand-lever, D. By pulling this lever towards him, the engine-man at once brings down the entire sole of the brake to bear upon the rail. The front brake is attached to one arm of a similar double lever, and is borne up free from contact with the rail by a spring, E, on the engine-frame. When the battery power is applied to the wire coils, the brake at once

Fig. 1.



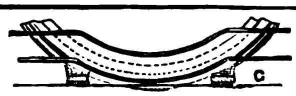
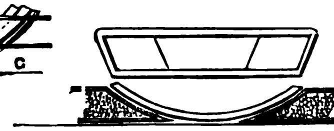


Fig. 3.



Figs. 4 and 5.

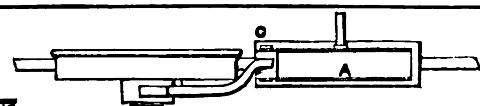


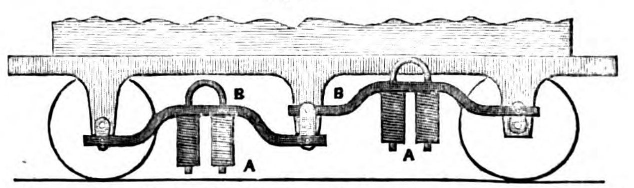
Fig. 2.

becomes a powerful magnet, the attractive power of which, towards the rail, overcomes the slight supporting spring, and brings it hard down. The construction of the brakes is shown in the plan, fig. 2, of the hind apparatus. They are entirely under the control of the driver, who can put them in action at pleasure without extraneous assistance.

M. Amberger's plans for giving the driving-wheels a powerful adhesion to the rails, are proposed under two separate forms. In one, the electro-magnets are made to act at a distance on the rails, so as to tend to bear down the engine which carries them, producing, in fact, what may be termed magnetic weight. The importance of this arrangement is evident, when the difference between this power and mere dead weight is considered. The magnetic power continually acts the same, whether on a plane or an incline. By another arrangement, the wheels themselves are converted into electro-magnets; the lower parts of the tyres only being thus magnetised, transforming into opposite poles the two points of contact of each pair of wheels with the rail. Each of these points of contact becomes the centre of action of the magnetising power, and all the parts of the tyre which are out of these points, act at a distance from the rail, and their attraction is added to the primitive adhesion. Figs. 3, 4, and 5, are details of the plan, as applied to the driving wheels of the engine, fig. 1, in which latter view the magnet is shown partly in section. This consists of a copper case, F, surrounding the lower part of the tyre, which runs clear within it. It is supported from the axle-box, and holds the coil of copper wire as in the former arrangements. Fig. 3 is a side view of the case with the coil removed, showing also a portion of the wheel tyre. At G G are two brushes working upon the face of the rail. The object of these brushes is to accumulate beneath the wheel iron filings, proposed by the patentee for use instead of sand, in producing adhesion. Figs. 4 and 5 are respectively a plan and vertical section of the case, corresponding to that in connection with the driving-wheel.

In his electro-motive arrangements, the patentee attaches electro-magnets to rods in connection with cranks on the driving-axles, as delineated in fig. 6, which is a side elevation of a carriage so fitted. Here,

Fig. 6.



A, are the magnets attached to the rods, B, both ends of which are coupled to cranks on the axles. The magnets are brought into action alternately, and as each is attracted to the rail beneath, it turns the cranks and propels the carriage.

REGISTERED DESIGNS.

ILLUMINATING GAS STOVE.

Registered for G. Knowles, Esq., *Woodend, Scarborough.*

The base of this stove is circular, made of cast-iron, and is 17 inches in diameter, which is thought to be the medium size required for ordinary use, but which may be increased or diminished as may be required. This base stands upon cast feet, about 10 inches from the floor. Within a groove, of the same metal, filled with dry sand, ⅜ of an inch in breadth, by ½ an inch in depth, measuring from centre to centre transversely across the bottom 13 inches, stands a strong glass cylinder, 13 inches in diameter, and 20 inches high. Within this groove is a cold air chamber, for supplying the burners with air, by means of apertures, formed in the bottom plate of the stove. At the top of this glass cylinder is a rim of cast metal, which encircles it, and on the upper side of this rim a sand groove is formed, in which stands the dome, made of sheet copper, which being about 16 inches high, makes the whole height of the stove about 3 feet 10 inches. The rim is supported by four cast-iron pillars, ⅜ of an inch in diameter, firmly screwed into the bottom of the stove where the feet are placed, and the rim is again screwed down upon the

top of the pillars, which gives an adequate degree of firmness to the whole.

In the centre of the bottom is a boss, 3 inches high, 5 inches in diameter, and $\frac{3}{8}$ of an inch in thickness, to which is attached a stay pipe or cylinder, 5 inches in diameter within, and rising up in the centre of the stove to the height of 2 feet 6 inches; the top being made wider at the end of the funnel of the ventilator, where the arid air from the burners, and the moist vapour from the water cylinder, meet and amalgamate before the heated air of the stove enters the room. Within this stay pipe is another cylinder, barely 5 inches in diameter, rising to within an inch in height of the stay pipe, in the centre of which is a water cylinder, 3 inches in diameter, and of the same height, but extending below the bottom nearly to the ground, the space between the two latter being filled with sand. These three cylinders may be made of sheet iron or copper. Surrounding the stay pipe is placed the reflector, of a round, segmental, or octagonal shape, 7 inches in diameter, and made of sheet copper, silvered or tinned on the outside, which, on lifting off the dome of the stove, can be taken out and cleaned at pleasure. This reflector is of the same height as the exterior glass cylinder. The gas burners surround the reflector in two rings, one near the bottom, and the other half-way up, 9 inches in diameter, each containing eight burners. The cock supplying the upper ring admits only three-fourths of the quantity of gas supplied to the lower, by means of a stop pin. These rings are connected, and are supplied with gas by means of a pipe introduced at the bottom of the stove, attached to the main. Each ring has its stopcock, so that one or both may be used at pleasure, but when one only is worked it must be the lower. A flexible tube for lighting the burners accompanies each stove. Provision is made for screwing on and taking off.

The waste of water in the water cylinder, by evaporation, may be easily supplied by taking off the dome, the amount of waste being ascertainable by means of a small floating buoy, and when charged for house purposes it only requires twenty inches in depth of water.

This stove affords not only heat but light; and the hot air is tempered and purified by means of the water cylinder, which renders it more fit for respiration than the air of any other stove yet invented. When the stove is used for ordinary purposes, the water in the cylinder is kept below the boiling point—(say, at from 100 to 160 degrees of heat)—by the sand cylinder, and by the water cylinder itself descending below the bottom of the stove. When used in greenhouses, or in places where much moisture may be required, the sand may readily be removed, and the space it occupies filled with water, which may be allowed to rise to any degree of heat.

FIRE-BOX AND FLUE FOR CYLINDRICAL BOILERS.

Registered for Mr. B. Goodfellow, *Engineer, Hyde.*

The peculiarity of Mr. Goodfellow's fire-box and flue, and the means by which he proposes to secure extraordinary economy of fuel, "combining strength with facility for cleaning out," will be found pretty clearly explained in our three illustrative engravings.

Fig. 1 is a front elevation of a cylindrical boiler, fitted according to this design, the brickwork being shown in section; fig. 2 is a corresponding longitudinal section of the same, a portion only of the boiler being shown;

Fig. 1.

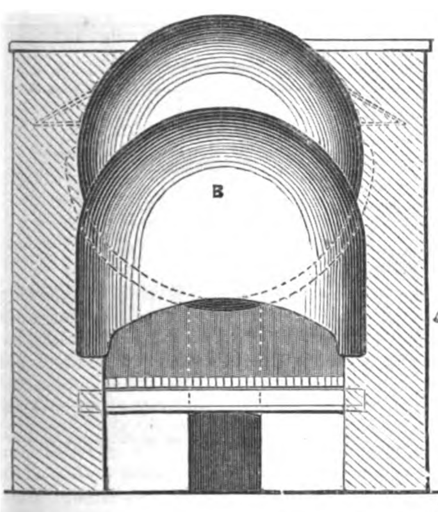
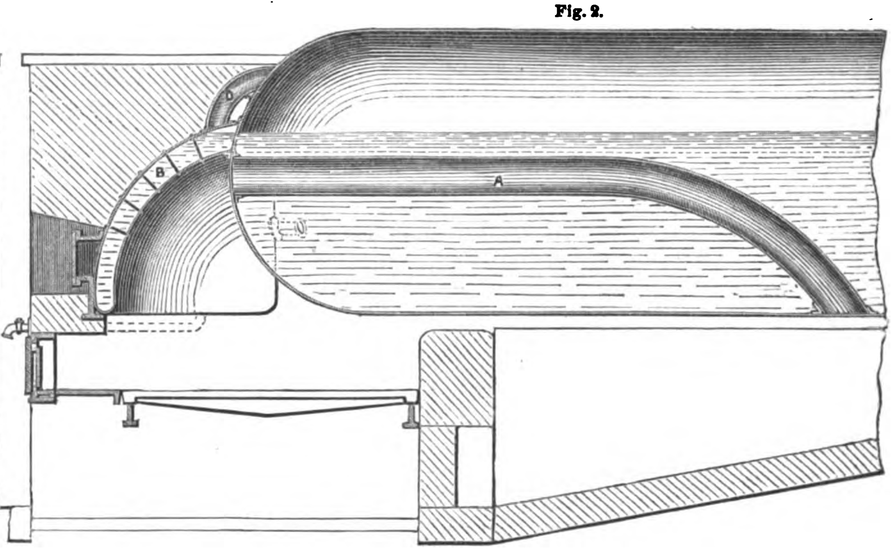
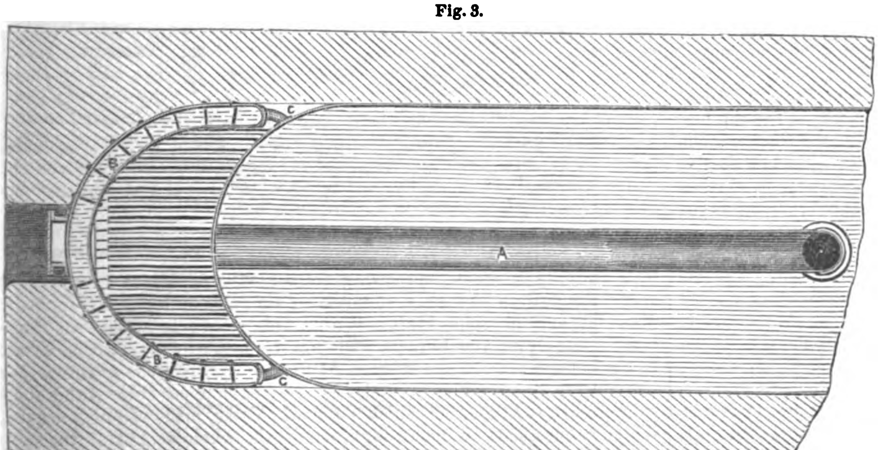


Fig. 2.



and fig. 3 is a plan, or horizontal section. A curved flue, A, is formed nearly in the centre of the boiler's end, and passes a considerable distance inwards, bending gradually down, until it opens through the bottom of the boiler behind the bridge. The fire-box, B, stands out from the front end of the boiler. It is formed of curved plates, with a water space throughout its entire surface. The water space is connected with the boiler by two side pipes, C, and a central layer pipe, D. Mr. Goodfellow's object in fixing upon this shape of fire-box, is to collect a greater amount of effective furnace heat. The curvature of the flue, A, is stated to be provided to allow for the expansion of the plates. The fire-box may be cleared out by the front manhole, E.

Fig. 3.



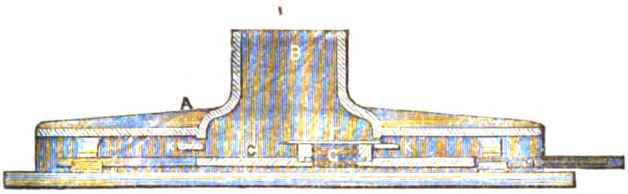
MACHINE FOR CUTTING CHICORY ROOTS.

Registered for G. Beasley, Esq., B.A., *Spalding.*

This apparatus is proposed as an effective means of disintegrating various roots, and in particular for cutting chicory. Fig. 1 of the engravings is a longitudinal section of the cutter, and fig. 2 is a corresponding plan. The upper plate, A, has cast upon it the hopper, B, and is fixed. The bed plate, C, is moveable, being free to slide

upon the V shaped grooves and rails, D, when actuated by the connecting-rod, E. A knife, F, is fixed to the ends of the moveable bed plate, immediately above the opening, G; and at H H are two rows of knives or cutters, their upper ends being inserted in slots formed in the knife, F, whilst their lower ends are attached to the bed plate by transverse bars.

Fig. 1.



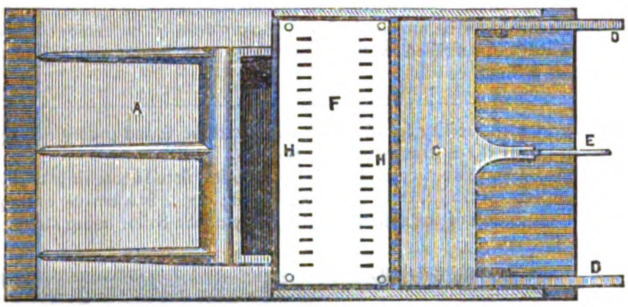


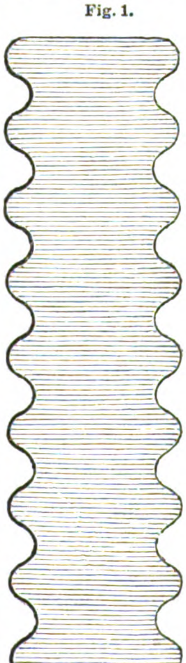
Fig. 2.

The chicory or other roots to be cut are placed in the hopper, B, whence they fall gradually on to the bed, C, where they are cut into slices horizontally by the knife, F; the two rows of knives, H, again dividing these slices vertically. Cross-bars are fitted at K, for the abutment of the roots whilst being cut. The small cubes produced by this duplex cutting action, fall through the aperture beneath the knives, into a screen attached beneath the bed.

SECTIONAL STRENGTHENING ACCOUNT-BOOK AND INDEX BAND.

Registered for Mr. James Wodderspoon, *Portugal Street, Lincoln's Inn, London.*

Fig. 1.



The object of Mr. Wodderspoon's invention is, to secure additional strength in the binding of large books, and removing the existing liability of the leaves to come asunder at the sewed parts. The "strengthening band" is also proposed to afford greater durability in the edges of indices of account-books. Fig. 1 represents a portion of the band, on a large scale, detached. Fig. 2, is is a view of a portion of a book, with the band applied, showing the leaves open; and fig. 3 is a portion of an index to which the band is adapted on the same principle.

The band has its two edges scolloped, or cut to an undulating contour. The last leaf of the first section is secured to the first of the third section, as delineated in fig. 2. Again, the last leaf of the third section is similarly secured to the first of the fifth section, and this sequence is preserved throughout the book—the intermediate sections being stitched through the band.

When used for strengthening the edges of indices, as in fig. 3, the undulating edge gives a greater hold upon the paper, as, should one of the projections become detached, the others, and the band as a whole, will remain perfect.

The failure of account-book bindings, and, indeed, of the bindings of all large volumes, is a matter of such frequent occurrence, that any remedial modifications of the plans for attaching the leaves, must be extensively welcome. Whilst Mr. Wodderspoon's design affords a vastly increased degree of security, the simplicity of the means which he has adopted, carries with it the very important point of economy.

Fig. 2.

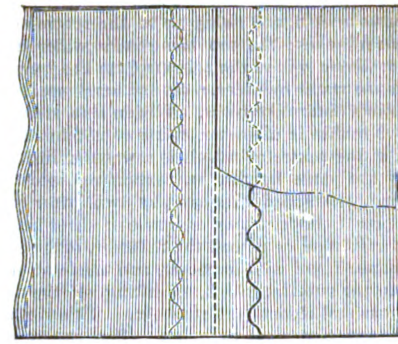
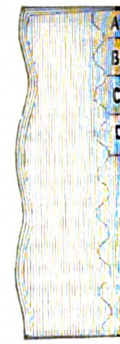


Fig. 3.



SAFETY WINDOW.

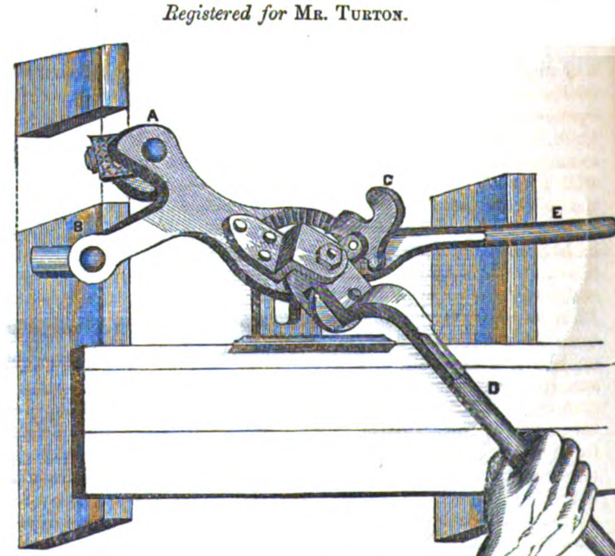
Registered for Mr. F. J. Brewer, *Birmingham.*

By Mr. Brewer's invention, the ordinary sash-weights, cords, and similar window fittings, are entirely dispensed with, whilst efficient provision is made for ventilation at the top, and for cleaning the glass inside the apartment. Our engraving represents the window, with its upper division open for ventilation.

The lower division, A, opens inwards on side hinges, B, like a door, the fastening, when closed, being by a button or spring-bolt. The upper division, C, is hinged at D, to the top bar of the division, A, and is thus capable of being set open to any extent by a cord attached at one end to an eye at E, and passed over a side-pulley, F, and thence to the fixed hooks beneath. The arrangement for opening the sash into the room, affords great convenience for cleaning the glass, as it does away with the necessity of any outside work; and by turning the upper portion down, the exterior of the sash may be cleaned without any elevation of the operator. The sash is let into a rabbet made in the frame-work and sill, and a moulding is put round the top and sides.

FLOOR CRAMP.

Registered for Mr. Turton.



Our perspective sketch of this cramp leaves us little to explain as to

its action. The instrument is placed parallel with the boards to be laid, with the two holding pins, A B, embracing a joist. The detent, C, is then raised, and the lever, D, is drawn over the handle, E, the cramp being slided close up to the boards to be laid. To give the necessary compression, the detent is put down, and the drawing round of the lever then forces the boards close enough to leave a scarcely perceptible joint.

REVIEWS OF NEW BOOKS.

A History of Naval Architecture, from the Earliest Period. By John Fincham, Master Shipwright of Her Majesty's Dockyard, Portsmouth. 8vo. Plates. London: Whittaker & Co. 1851.

The origin and progress of naval architecture are associated with the development and course of civil and commercial power in some states, and with the extension of that power in others. Our own country is a remarkable illustration of the identity of national power and prosperity with the possession of fleets of ships. Hence it came to be regarded as a maxim, that he who could command the sea, could command the commerce of the world; and that he who could command that commerce could command the world. Now, quite apart from the idea of universal empire, which, in the present constitution of the world, would be a vain and foolish chimera, we see how great importance has been attached to shipping. It is easy to underrate this importance; but it is not easy to define its limits. Ships should be regarded, not simply as an instrument of power and prosperity, but as the result of an art and a science, of which the volume before us presents a history. In the infancy of civil power in England, this art existed in a rude state, and the science was unknown. The introduction to this work informs us that, "it was not only during the earliest ages of the employment of ships, that the art of building them had to be carried on separately from the aid of science in their construction; but this state of things has marked almost the entire course of history. If we turn back to centuries that have passed away, we perceive that ships have been built much in accordance with the tastes of the ages, respectively, determined ultimately, as mechanical skill was able to give a good, or only an indifferent effect to the designs of construction. But there were tastes proper to countries as well as to periods, marking a state of rudeness or of comparative refinement, long before anything like a scientific basis was laid for so important an art. The development of art *never waited for this basis*; necessity impelled it onwards; and along with many errors, it always associated some important truths; and, gathering on the side of truth, and rejecting on that of error, a long course of experience produced ships of a high order of excellence, and capable of fulfilling the objects of their respective periods, before any theory of naval construction existed; perhaps fully as much to the satisfaction of those who built, and of those who commanded them, as ships of the present day fulfil their destinations."

If we look back to the origin of the *royal navy* in England, we see a particular taste developed. It was an era of transition in this country, in more respects than one; and princes were characterised by a love of magnificent display. This taste was embodied in the *Great Harry*, and in the *Henry Grace de Dieu*. But ships were soon wanted, rather for actual service to the state, than for an exhibition of royal splendour; hence a change took place in their character; and, instead of such towering castles as those two ships were, the ships which went out to oppose the Spanish Armada in 1588, were so small, that the Spaniards shot over them, in discharging their guns, whilst the English ships, more easily manageable, could go near their enemies, discharge their guns, and retire with little danger to themselves. The seventeenth century witnessed the advancement of the naval power of England to still greater eminence; wars became especially *naval*, shipbuilding having so improved as to supply the means of planting the standard of British power on the ocean. The character and capabilities of ships improved, as the greater weight of responsibility to the state was laid upon the navy. Mr. Phineas Pett, master of the shipwrights' company, contributed much towards improvement in the construction of ships; and as he kept his eminent skill a secret in his own family, his labours, and those of his son, extending over a considerable period, were of great value to the country. Sir Anthony Deane was one of the most eminent naval constructors of that century; but in his time fixed rules were laid down for the construction of ships. The same happened in France about the same time; and the improvement, which had been remarkably rapid before, was arrested. From that period, the British navy, although increasing numerically, and in aggregate power, by immense strides, was subject to serious complaints at different times, that the character of its ships was below the wants of the public service. It was sought to improve the ships by revising the establishments issuing from an office (that is, that all ships of the same class should be of the same principal dimensions), instead of returning to the superior plan of the seventeenth century—allowing and encouraging the most eminent men to construct ships to the best of their ability. Naval architecture was long retarded by this most pernicious system. It has at length obtained the freedom which, in all things, is necessary to progress; and liberty has not been given in vain.

The theory of naval architecture has been but little known in England; and, with shipbuilders of the old school, it was thought, as they were ignorant of it, that it might be very well dispensed with. The subject is coming to be regarded with more intelligence now; theory is partially applied, and the importance is evident of making science bear upon all the conditions of construction. The introduction of this work is a short history of the application of science to shipbuilding. The first effort to realise this application seems to have been in the latter part of the seventeenth century; and from that time down to the close of the eighteenth century, all the speculations on this subject were confined to the continent. The stability of ships was then investigated in England; and the principles developed by Mr. Atwood, in two papers which he read before the Royal Society, have become the basis of certainty as to that part of the subject, in all constructions of ships, in which the calculations which he indicated have been carefully made. We have no doubt that the introduction will be read with interest by all who care about the theory of naval architecture. We recommend the work to the perusal of nautical and scientific men.

Mr. Fincham, the author of this volume, is an officer of long standing in the service of his country. In this position his opportunities have been blended with habits of observation, the results of which are here presented to entertain and instruct his readers. Thus, much of the information contained in this history bears on what has transpired within the present century. The rise and progress of steam navigation are extensively treated on, in both a commercial and national point of view. When time serves, we must return to this portion of his theme, which is likely to interest both engineers and steam-packet companies.

On the Application of the Sewer Water of Glasgow, and Liquid Manure generally, to Agricultural Purposes. By W. Robertson, C.E. Glasgow: Ogle. Pp. 36; plates. 1851.

The late Mr. Smith of Deanston, one of our most indefatigable agricultural and sanatory improvers, has calculated the annual value of the sewer water and liquid manures of the United Kingdom at £28,000,000; and upon this basis has shown us, that each individual member of the population actually loses £1 per annum for lack of an organised plan of the kind which Mr. Robertson here advocates. In the midst of the agitation as to sanatory measures, the little pamphlet before us must be felt as a well-timed piece of suggestive information, which, in its immediate application to Glasgow, may render efficient service to the promoters of agricultural economy, and the sanatory regulations of towns elsewhere. The author remarks that—

"For the economical development of a system of manuring with the sewer water of towns, it is preferable to have a large extent of low flat country adjacent, so that the sewage may be cheaply raised by means of engine power to an altitude that would offer an easy distribution by means of gravitation, and at the same time carry off whatever accumulations of matter may take place within the pipes. As such a tract of land is not to be found in every locality where sewage is produced, it follows, that there are districts which cannot be supplied so economically. There are, however, cities, towns, and villages in the United Kingdom which have adjacent lands favourably situated for its distribution, and where it consequently can be applied at a very cheap rate."

As regards the presumed benefits arising from such a disposal of the liquid matter, he says—

"To the Clyde Trustees it would be beneficial, as it would prevent the filth and *debris* from flowing into the river, and thereby be the means of reducing the dredging account. The present yearly expense for dredging the river is about £7,000, and it can be easily shown that a portion of this sum is spent in removing the *debris* flowing from the city sewers. Taking the average production of the sewage of Glasgow at the low section of 10 square feet, flowing at the rate of one mile per hour, 13 cubic yards of solid matter flow into the Clyde during that time, or upwards of 110,000 cubic yards per annum. The greater part of this is undoubtedly carried about with the tides, and at last expelled by a freshet, but a considerable quantity of it must subside in the harbour and the reaches below it. This, however, is not the only expense or inconvenience it causes on the Clyde. Any person travelling by steamboat from the harbour during the summer months, must have observed the abominable state of the water, arising from the decomposition of the animal and vegetable matter brought into the river by the sewers, emitting, more especially during the ebb tides, the most disagreeable effluvia, to the annoyance of every person who had many minutes to wait for the departure of the steamboat, and producing disease, with all its concomitant evils, to the inhabitants residing in its neighbourhood."

We may safely leave this part of the argument to the consideration of any visitor to the Clyde.

The agricultural district proposed to be laid under Mr. Robertson's scheme extends along the south side of the river, above the village of Cambuslang, eastwards; to the point of junction of the Cart with the Clyde below Renfrew, westwards. On the northern side of the river, the

hilly nature of the ground makes it less favourable for distribution, but even here a considerable portion may be taken in. He proposes either to force the liquid directly through pipes, or to elevate it by steam-power to suitable reservoirs, whence it may be distributed by gravitation. The calculated cost of works for the collection is £40,000, and that for the distribution £26,000; or a total of £66,000 in round numbers. This is equal to £3. 8s. 9d. per acre of land under the command of the reservoir, or £5. 3s. 1½d. per acre of the land estimated to be manured. This scheme embraces 75 miles of fire-clay pipes.

When we remember the beneficial results of the few minor isolated examples of the application of the system which are already in existence, and still more, when we try to imagine the purity of the river in its unpolluted state, we can have little hesitation in assuring our readers that Mr. Robertson's remarks may be read with profit.

The second portion of the pamphlet refers more particularly, as the title indicates, to the interest of the practical agriculturist. The arguments of the writer are here backed by illustrations of "Coode's Patent Irrigator," and plans of a cow-house and sheep-pen, with liquid manure tanks. Whilst the earlier pages deserve the attention of all municipal authorities, the latter ones may call for that of the farmer.

CORRESPONDENCE.

AN "ARRANGEMENT" WEEK AT THE EXHIBITION BUILDING.

I have been to the big city, and have been inoculated with many—indeed, I think I may say, most, if not all of the many feelings awakened by "the Exhibition of the Industry of all Nations," even in its embryo state. On the day your Journal will be in the hands of your readers, the building will be open, at least—so say the Commissioners, and—so say I. I suppose, sir, you will have received no anticipatory, electro-telegraphic message of *that* day's events, and I need not be under any apprehensions that you will not be fully and immediately informed of all that is, or can be made public, up to the time of "going to press;" and as I come in the character neither of a clairvoyant, nor even as a mere mundane reporter, endowed with the powers "connected with the press," I trust to your editorial kindness, to give me a corner of your Journal for a little bit of gossip. In short, sir, I have been to London—I have been to Hyde Park—I have been inside the building—I have "aided in the arrangements" (that's the point, and I can show sceptics the magic touch of "M. Digby Wyatt, Sec.," for the truth of it), and I am inclined to exercise my birthright of grumbling, I am inclined to be critical—as every dabbler in print is inclined to be; I am also very greatly inclined to be very well satisfied with all that everybody has done, not by any means excepting myself—"who shouldn't say it." Seeing my past and present condition, pray, good Mr. Editor, let my future be in keeping with the rest, and let me have just one quiet little nook wherein to breathe myself awhile, and say, like Handel's bellows-blower,—"*We* did it."

The preparatory anxieties of labouring at the objects to be exhibited, the pangs of deciding as to what to send, and how to get it, I leave to the personal experience of any of your readers. Speaking in a friendly way, Mr. Editor, and from my own experience, I may say, these preliminary troubles greatly resembled those happy, awkward, hopeful, miserable days—the days we go, or went, or are going—to woo. Out comes the best foot foremost, and then, "aye blate," we blunder, but there's some good stuff at bottom, so on we go, awkwardness vanishes, difficulties are surmounted, hopes are realised, and we stand at length in "the happiest moment of our lives," to run the race with all the world—we and ours together, be that *ours*—wife or work. Those who indulge in outstretched similes, will find some time in a lover's life to compare to that uneasy period in the life of an exhibitor, when, after spending months of days and *nights* of toil, he commits his precious treasure to the ruthless hands of the carrier—perchance to be lost or stolen, broken, or too late. The mere memory of it is enough for me, what, then, would the realization of fears have been? You have read, I doubt not, of that unfortunate man, who, after nine months' labour on an ornamental plate of glass, had it lifted from the waggon by the wind, and dashed to pieces before him, ruining all his hopes when almost at their crowning height; I have read of him in the oft-told newspaper tale, and I have heard of him in private life. A friend was at the building, and excited previously by good success, pleased at the work of his hands, or of his share in the objects he was in charge of, the excitement was so greatly increased by the "week of arrangement," by the arguments with the officials and Executive Committee, and by the "Exhibition fever" (for there is one, Mr. Editor, and I think I am myself, in some degree, a fever patient), that it proved too much, and I found him stretched on a bed of sickness with inflammation of the brain. In conversation with his medical attendant, I mentioned the case of the poor man who saw his labours so cruelly destroyed at the time of their completion; the doctor said he was attending that person also, who, as well as my friend, though from very different causes, was (I hope temporarily) deranged. So, sir, pleasant as it is to work "with a will," at objects which please our imaginations, there are but too many and sad proofs, that the worker's brain may be overworked; and, even if the work remains, it is a monument of a mind decayed, instead of being—as each man hopes in his career—a mark or signal of the distance travelled—a sign that the worker still moves onwards.

I found myself at the building among the more fortunate ones, those who had to thank their stars that all was safe. Looking for your packages on the spot, was another, and often a very queer phase of the exhibitor's life. First, you had to pass between two sober-coated policemen, who demanded your "pass" or your business. Foreign exhibitors were shown (outside) to the one end of the building, and English exhibitors to the other end. The grand and central entrance was given up to the general offices. These were all little deal-box offices, with printed paper name-plates, wearing all the well-known names of the Executive Committee, and Messrs. A—B—C—D—E to Z, heads of departments, and "the tail" of the committee, amongst whom the exhibitor had to look for the particular and peculiar guardian of his *Class* if everything was not to his liking, which, I believe, never was the case. Then he had to visit the keeper of the catalogue, look at the proof, and see how cruelly and inexorably every little piece of self-laudation had, or ought to have been, cut out. The conscientious revisers would almost appear to have felt it incumbent to cut out something of everybody's; a regular equality democracy, with a president using the scissors impartially. In some cases, mere description or names of articles had gone—the wheat and tares together, but corrections with the pen were allowed; I tried my hand at one, the addition of just nine little words, and I hope the mystic number may escape, intact, the dangers of revisers and scrutineers. In my own case, the acquaintance with several of these officials was formed after I had secured my pass. These "open sesames" were of nine kinds—day tickets, periodical and perpetual; small green card, *perpetual admission everywhere* (so said the Commissioners' placard); large green card, limited time everywhere; green paper, daily everywhere. The building itself was divided at the transept; the Eastern division being for foreign and colonial productions, the Western for British goods. Mere exhibitors, with no friends at court, could get no green tickets, but merely a blue one for the foreign end, or a white one for the British end (the size of the cards, and the *paper*, bearing the same significance as the green ones), with a restriction to that particular spot where the goods in his class were to be shown. Having some connection with classes at both ends of the building, I became the possessor of two large cards—a blue and a white one—to obtain which, I underwent an examination of the presiding genius, in the shape of a soldier—a sapper and miner—and duly informed those whom it might concern, all such particulars as name and address, class, exhibited in, and so on. Thus armed, I "passed" through sundry other officials, and entered the centre aisle, and looked, as I think every one did and must do, at the beautiful and magnificent structure of the Crystal Palace. I saw it in its rough coat, budding, as it were, early in December, the same day it was first used as the meeting-place of the Commissioners; and I saw it again, from the Eastern end, where the internal painting was nearly all complete, like a butterfly sprung from the chrysalis, and glorious in light. I had read and heard many objections to Mr. Owen Jones' method of colouring the interior, and went prepared to object; my preconceptions vanished, and I felt that the decoration was worthy the erection. It is hardly necessary, except perhaps to refer to, to describe the colouring;—the columns striped, alternately white, blue, white, yellow; the girders striped, white, blue, white; the sash bars white, and the *under side* of the gutters and girders, red. The effect, to me, appeared all elegance and lightness. I had been told, and rather thought, iron ought to be painted iron, and wood—wood; and so expected to find some lurking feeling, that the decoration would convey the idea of an attempt at imposition—an optical delusion. On the contrary, so light and elegant did the whole fabric seem, that iron, iron, iron, and nothing but iron was loudly proclaimed by every bright line of colour—by every vista of graceful chromatic perspective. Had the "*crocus martis* naturalists" (for red rust or *crocus martis* is, I suppose, the natural outward colour of iron left to its natural course)—had these sombre gentlemen had their way, we might have said, "it looks almost heavy enough for *wood*;" but now there is no mistaking the giant's bones,* and iron, mighty iron, wears its gay attire with becoming grace, and modestly, though

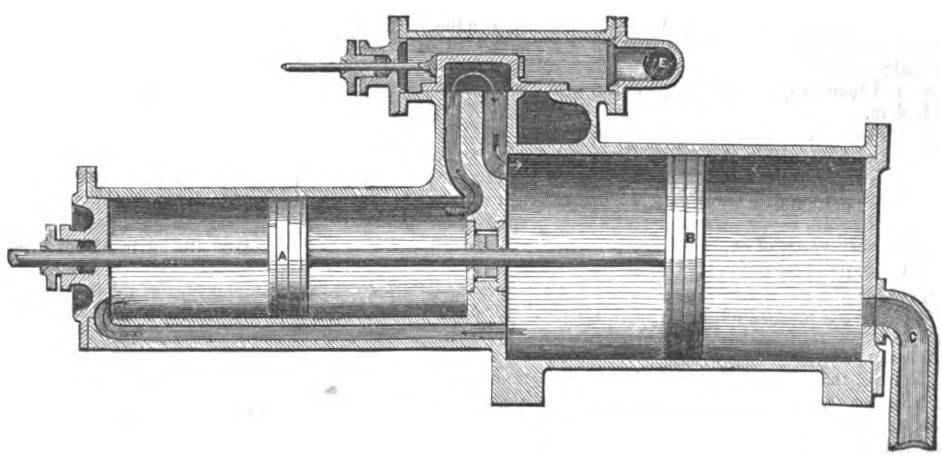
* Iron has been aptly called—"The bones of the giant Civilization."

clearly, asserts its might, and thence its right, to uphold these roofs and walls which form the palace of air and light—the meeting-place of the peaceful mighty of the earth. I admired the thought of colouring the under side of the gutters and girders *red*. As you look along the aisles, the gutters are long unbroken lines, marking out the beautiful perspective by their contrasting colour; for, at a little distance, the blue, yellow, and white, form such harmonious combinations, that marked lines or methods of construction are necessary to show fully the perspective of the whole—the crossed bars of the girders interlacing into one gradually receding aerial tint, to which the straight red gutter lines and rod-like pillars give startling distance and effect. Had a dark colour been adopted throughout, my recollection of the unpainted pillars and girders, convinces me that the effect would have been a dark rain cloud resting on a forest of stumps. The red on the under side of the girders, forms transverse lines to the perspective lines of the gutters—lines so narrow in the distance, as to blend imperceptibly, but most agreeably with the other tints; and near the eye, in broader lines, distinct and clear, they please the eye like those bold, dark, and vigorous touches which every master bestows on the foreground of his picture. But I have forgotten the exhibitors' cases, as I did those I sought. Let me advise all future inexperienced showmen to make their packing cases doubly, trebly strong. The article I was looking after was fragile; where could the cases be? Here, there, and everywhere the exhibitor must look. At length they are found—or at least their ends are, but their bodies covered with others very precious to some folks, though just now a nuisance to you. Away to the head, or one of the tail of the department, and back with a gang of soldiers, who, kindly, zealously, and ably—officers and privates alike—assisted those who needed help in moving, lifting, and replacing. All nearly clear, and you find one hard corner of one of your strong cases has found out a weak place in another one, and the white lines and splinters show violence outside, if haply it be only there. No peace of mind, then, for the exhibitor, until, the lid removed, he finds (at least I fortunately did) all inside is safe, thanks to careful packing, and extra—extra precaution; thanks indeed, for close at hand is your trade rival's case; his specimens, unlike your own, destroyed. I have intentionally avoided all mention of the previous correspondence as to space, &c., but when the goods were found, and convenient to the spot allotted to them, all the grievances before written of were revived, and new ones found. Your space is too small, your neighbour's too large; you are placed with a north light, south light is essential; the English spirit of grumbling comes over you, and you must have your say. It happened in my own case, that several adjoining exhibitors had two grievances in common, and with that common though foolish feeling of petty jealousy, had refrained from speaking to, and acting with each other. Tom, and Jack, and Bill, had each separately and repeatedly beset the Executive Chief with complaints and proposals; I did so too, but finding we were all in the same boat, broke the ice, and gained my point by calling a meeting of the "showmen," and appointing a time for our waiting on the Chief. We met first to discuss—foreigners and Britishers together, the only class, I believe, in which they are not divided; so the knowing ones may make a shrewd guess at *my* class. On one grievance we were unanimous, the result desired was the same with all, the mode rested with the committee; and, on the other point, singularly, the foreigners to a man advised one thing, and, equally unanimous, the Britishers another, and the latter, as the more numerous party, carried the day. But I dare say, you and your readers will say—enough, mayhap too much, of yourself, tell us something else. This is no easy task, after the lengthy columns in the daily papers, and the engravings in the weekly papers and periodicals. The principal thing which forced itself upon my attention was, the division of the building into British and Foreign departments. In the British department, England, now as ever, expects every man to do his duty. We do look for and expect great things, and I believe we shall not be disappointed. It was no feeling of this kind, but the comparison which—whether intentional or not, I know not—every one must make, that the proportion of goods per square yard of the allotments, is nearly the same as the proportion of population per square mile of the respective countries. The British are crowded, every foot is made available. France, so far as I could see, was the most crowded amongst the foreign spaces; whilst other nations have "ample room and verge enough" to spread their skirts abroad, and strut in all the dignity that room and width can give. The numbers on my two tickets also show the same thing; the foreign one is near 300, the British one still nearer 2,000—nearly seven British to one foreign, and it must be remembered, many British, like myself, have foreign tickets, while the reverse is rarely the case. I believe the result will be, all foreign articles will certainly be seen to good advantage, but also, so that every defect as well as every beauty will be readily discerned by the practised eye, and we shall see what they can do, doubtless, in many instances, to take the shine out of some of us. A foreigner has said, "You may travel through Great Britain without an interpreter, if you know only how to say, 'How much?'" and this same interrogatory I would apply to foreign produce, not only as the stranger meant—to money, but to work. A beautiful or novel article may, and doubtless will be exhibited, not in units, or in tens, but by hundreds and thousands, east and west; the practical test is, "How much?" "How much can you make?" "How much can you use?" "How much does it cost?" and "How much can you get for it?" Old Britain—Anglia, Scotia, and Hibernia, will live, and look, and learn, at the World's Fair. In conclusion, I think, individually, I have ground of complaint against the Executive Committee, and most exhibitors will agree with me that a little more experience was needed. But apart from self, looking at the whole as a spectator, I must express my great admiration of the building and its arrangements; both as to officials and space, there has been no want of workers, and they *have* "worked with a will." D.

April, 1851.

MORTON'S DOUBLE EXPANSION ENGINE.

Having noticed in the *Practical Mechanic's Journal* for July, 1850, a plan of horizontal double expansion engine, by Mr. Sims, I have been induced to forward you a plan of my own of the same kind, wherein the pressure on the small piston is equalized in the down stroke, so that the whole power of the expanding steam is made available for actuating the large piston. The figure exhibits a longitudinal section of the high and low pressure cylinders and slide-valve, as given in plate 52 of Mr. Sims' engine; a reference to which will materially assist in



pointing out the peculiarity of my modification. The two pistons are shown at half-down stroke, the steam being in the act of exhausting from the lower side of the small high-pressure piston, A, to the upper side of the large one, B, as indicated by the arrows; whilst the equalizing effect upon the small piston is produced by opening a passage to its upper side, from the upper side of the large piston. Thus the pressure on each side of the small piston being equal, I gain the same amount of reflective pressure on the large piston during the down-stroke, with a relative area between the two pistons of 3 to 1, as Mr. Sims does with a relative area of 4 to 1. Unlike his plan, my two cylinders are cast with a division piece between them. This division has external packing-rings, with tin plates or discs, one on each side, so as to allow a clear way for the boring bar, C, in the passage from the bottom of the large cylinder to the condenser. When the slide-valve is reversed, the steam is exhausted through the port, D, so as to equalize the pressure on the piston, B, for the return-stroke, and producing a vacuum on the upper side of the smaller piston. At the same moment, fresh steam is admitted by the pipe, E, from the boiler to the under side of the small piston.

Dundee, *April*, 1851. ALEXANDER MORTON.

ON STEAM-BOILER EXPLOSIONS, AND SOME NEWLY-DISCOVERED PROPERTIES OF HEAT.

V.

As several important inferences can be better drawn at the fitting opportunities than at present from the foregoing facts, we will, therefore, now proceed to show some other properties of stame deserving attention; and first, the great celerity with which steam takes up heat by contact with metallic surfaces and becomes stame, is incomparably greater than the speed with which water takes up heat and becomes steam, and probably is equal to the speed with which steam imparts heat to any colder substance by contact therewith, and which property of steam appears to be limited in velocity, only by the conducting capacity of the substance in contact; for by calculating the respective capacities of the cylinder and of the heating coil of pipes, and speed of piston, it was apparent, though the stame was continuously increased in temperature 400 degrees above the temperature of the steam from which it was produced, yet every volume thereof passed through the heated coil, in less than the seventh part of a second.

This celerity of transformation of steam into stame of greater volume, combined with the little quantity of caloric required for the transformation, compared with the great quantity both of caloric and of time required for the formation from water for a small volume of steam of equal tension, if these considerations are compared with the well-known slow evaporation of water from unduly or "greatly heated" surfaces of metal (elaborately set forth in the Franklin Institute experiments), these joint considerations would show how much more probable, as well as how incalculably more sudden, certain and powerful agent for mischief is stame than steam.

But as we are also well assured that stame parts with its heat instantaneously to any colder substance in contact, we may now from these premises understand, how a sudden abstraction of steam from a boiler may cause an explosion, that might not have occurred under the same circumstances, without such sudden abstraction; and it is easy to imagine such circumstances may have occurred, when a boiler has exploded soon after an engine has been started that had been temporarily stopped for a short period, as for transfer of passengers and goods at a wharf, which unhappily is by no means a rare occurrence.

During such a period, the engine being inactive, the cylinder becomes cooler—the pumps being inactive, the water becomes deficient in boilers—lower portions of the boilers become uncovered with water and overheated; the steam in contact with those portions becomes overheated also, and then as quickly transports the heat from lower to upper parts of boilers.

Now, as the tension of steam in boilers would be little affected by this transfer of heat within the boiler, the usual discharge from safety-valve would be so little affected thereby as to appear satisfactory to the engineer; and as the engine had previously worked satisfactorily, no danger would be apprehended, though the boiler was then preparing for and approaching the very verge of explosion.

The frequent records of such calamities have often shown, that the explosions seldom or never occur while the steam is at its greatest tension, nor till "the engine has made a few strokes," or till "the boat has got one or more lengths from the wharf," when, if at all, an explosion ensues.

Now, if these frequently occurring circumstances be fully considered, it will appear, that with free acting safety-valves the greatest tension of the steam must have existed previous to starting the engine, for as the tension of steam cannot be sustained an instant in contact with any substance colder than itself, on starting the engine the cooled cylinder must be heated with rarefied steam, which will consume or use up several volumes of steam beyond the volume required for filling the cylinder when heated; while for heating the cylinder there will be required many more volumes of stame than of natural steam, proportionate to the very different actual quantities of caloric contained in those different compounds of water and heat. The tension of steam in boilers so circumstanced, must therefore be for some time rapidly reduced at every stroke of the engine, till an explosion ensues, if at all, from some unknown cause under lesser tension.

Now this occult cause may be explained. The rapid abstraction of rarefied steam from the boiler suddenly lowers the pressure upon the heated water in the boiler, and a portion of that heated water as suddenly flashes into natural or dense steam, which is as suddenly transformed by contact with the extensive heated surface of boiler into a volume of stame, of such greater magnitude and tension, that the safety-valves cannot discharge, nor the boilers retain, and explosion necessarily occurs; and hence there may be seen, how the opening of large safety-valves, or the fusion of large metallic substitutes for valves, may, under such particular circumstances, occasion the direful catastrophes they were specially constructed to prevent; for it is evident, the more rapidly the stame is discharged from boiler, the more suddenly and perfectly will the consecutive changes just enumerated take place.

In our description of experiments with a high-pressure boiler, we anticipated greater profit from converting low steam than high steam to stame of the same temperature, because of the greater degree of expansion to which it is subjected, and which we have now found experimentally to be true. For we connected a small condensing-engine by separate pipes and stop-cocks, with a boiler and steam-heater attached thereto, whereby the engine was worked for an hour alternately with steam or with stame, the steam being always of the same uniform tension in the boiler, as the safety-valve was loaded uniformly with fifteen pounds per inch, and the steam always blowing off from safety-valve, was of the uniform density of thirty pounds per inch within the boiler during every experiment.

The vacuum in engine was measured by a mercurial guage, and produced and maintained by causing the exhaust steam or stame to pass respectively through a long coil of metal pipe placed within and on the bottom of a large cistern filled with cold water, whereby the steam or stame was condensed into water in its passage to the air-pump, situated in a small cistern near the engine, and into which the cold condensed water was delivered after the heat had been separated therefrom, and retained in the water in the large cistern, whereby and wherein the proportionate quantity of heat absolutely employed and expended for working the engine in each separate experiment, became both readily and accurately ascertainable.

By employing this apparatus, we observed two distinct results or general laws:

First, we found that the hotter the steam was heated in its passage to the engine, the less was the heat imparted in the same time to the water in the condensing cistern.

Secondly, we also found the hotter was the steam heated in its passage to the engine, the more effective and powerful the engine became, till this increased effect amounted to a very considerable per centage. This fact was very plainly shown by the dynameter attached to engine which was maintained at same speed; and although the heated steam had to pass through a heated spiral coil of pipe, of somewhat less diameter, and of ten times the length of the shorter direct pipe, through which the unheated natural steam was conducted to the engine.

This fact can only be accounted for by the far rarer fluid stame moving with greater celerity under the same pressure as the denser fluid steam, and this one fact establishes another, that stame is a vastly rarer fluid than steam.

Thus the efficiency of the first was found in different experiments, in just proportion as the stame was heated beyond the temperature of natural steam, till we found it about six times as effective. To do this, however, we are obliged to substitute a heater with a larger proportionate heating surface, than one-fifth the heating surface of the boiler as employed in the previous experiments with high steam; and we have no doubt, that with a larger proportioned surface of heater than we have yet employed, the efficiency of fuel may be further increased by using stame of a higher temperature, as the experiments hitherto made coincide very satisfactorily with the general proportions found by the different eudiometers, distilling apparatus, and deductions therefrom.

Now the extraordinary discrepancy between the learned chemists who stated, it requires 480 degrees of heat to double a volume of steam, and our experiment showing that four degrees of heat doubles, and sixteen degrees of heat trebles the volume of steam, is easily accounted for, as it is merely the difference between a seemingly well-grounded theory of learned men, and an absolute fact discovered by experiment. For those philosophers having found that it required 480 degrees of heat to double the volume of all the different gases, and as oxygen and hydrogen gases among the number are composed of all the elements contained in steam, namely, oxygen, hydrogen, and heat, they theoretically inferred, *per saltum*, that steam and all vapours were subject to the same law of expansion, which is now shown to have been one of the most unfortunately learned guesses to be found on record. A further examination of the peculiar properties of steam, and the elements of which it is composed, exhibit such irreconcilable distinctions, that all the theories philosophers have coined for explaining the nature of heat and its combinations with ponderable matter, will utterly fail to explain.

When a pound of hydrogen is burned in a calorimeter, it, combined with eight pounds oxygen, forms nine pounds water, and gives out as much heat as will melt 320 lbs. ice (Dalton), hence one pound of those cold atomic elements in a gaseous state, contain as much of the elements of heat as will melt 35·55 lbs. ice.

When one pound steam of any temperature above 212° is condensed

within a calorimeter, it forms a pound of water, and gives out as much heat as will melt 8·35 lbs. ice; so that 4·25 times as much of the elements of heat were separated from the pound of water derived from the cold gases, as was separated from the pound of water derived from the hot steam. Nevertheless, the volume of steam and of the gases under atmospheric pressure is about three to two in equal weights of each (so that the gases are much less expanded by heat, though they contain such a larger proportion of it). An addition of 480 degrees of heat to the gases would only double their volume, while the same addition of heat to steam would increase its volume more than tenfold; the small abstraction of 180 degrees of heat from steam, would reduce its volume to $\frac{1}{1700}$; while the abstraction of an equal number of degrees of heat from the gases would reduce their volume little less than two-thirds; while the pounds of ice melted, by the heat obtained from equal volumes of equal tension of thirty inches mercury, will be as follows:

Oxygen and hydrogen gases at.....	50 degrees,	25·33 lbs.
Steam,....................................	212 "	8·35 "
Stame,....................................	650 "	1· "

The elements of heat in the gases are evidently in some peculiar and definite state incompatible with any known theory of heat. This state cannot be termed "latent heat," because the gases are permanently maintained in an elastic though very subordinate state (because the same equivalent of heat contained therein would suffice for producing more than four volumes of steam of equal tension). It is not heat, because the gases may be exposed to the most intense cold, without being reduced from a great volume of elastic fluid to an inconsiderable volume of water or ice. The elements of water too therein, are as evidently in some peculiar state of combination with elements of heat, unexplainable by any known theory of heat, being irreducible to the wet, liquid, or solid states, by any degree of cold.

From the foregoing and subsequent considerations may be deduced the inference, that heat is a compound of more simple elements, just as water is a compound of more simple elements, and that the simple imponderable elements of imponderable heat must have as distinct affinities for ponderable matter, and as contradistinguished as are the well-known affinities of water or its elements for other elements; and therefore the newly-discovered properties of "stame," though so wonderful to our conceptions, is no more wonderful than the other distinct properties possessed by the same elements in the foregoing table.

That heat is a compound of other elements is evident when heat is evolved by combustion, wherein two essentially chemically distinct elements, a combustible and a supporter of combustion, must be present, for from neither of which alone can intense heat be produced, though so abundantly from the compound elements employed.

That heat is a compound of the two different electric fluids appears evident when they are brought in contact (after travelling any distance over cold wires) are instantly transformed into intense heat, just as are the different elements of heat in the gases when brought into more intimate contact by an electric spark, or when solid fulminates are exploded by any blow which brings the opposite elements therein into closer contact.

That heat, light, electricity, and magnetism, exist uncombined in immense quantities, in the hardest and coldest bodies in nature, may be easily shown by the following experiment:

Strike a few sparks with a flint and steel, held over a sheet of paper. These sparks collected and viewed with a magnifier, will appear of various vitrified forms, of a brown colour, considerable lustre, of different magnitudes, some one-twentieth of an inch in extent, all differing greatly both in form and chemical properties from the colourless fragments of flint with which they are mixed.

Repeat this experiment within a hand-basin filled with cold water, wherein the flint and steel are held while the sparks are struck under water, when the sparks will be found of the same colour, forms, and chemical constitution as those sparks previously struck in air.

Transfer the sparks to a watch-glass, pour over them a little muriatic and nitric acids, apply a gentle heat, and the sparks will be dissolved in a few minutes.

Pour the clear solution into another watch-glass, evaporate to dryness, pour water thereon, and a copious white precipitate (silex) will subside.

Transfer the clear solution into another glass, add a few drops prussiate ammonia, and a deep blue precipitate (prussiate of iron) will thus be obtained.

On considering the result, we are assured, that by the collision of cold flint and steel in cold water, as intense a heat has been momentarily produced in that unfavourable situation, as can be produced by the most powerful galvanic battery, under favourable and skilful management, as the heat thus produced under water greatly exceeds that produced in any kind of furnace, having not merely fused, but so perfectly vaporized two distinct masses of flint and steel, that the ultimate and intimate atoms thereof were perfectly separated, or they could not have mutually penetrated and chemically decomposed each other, and recomposed a perfectly new and distinct chemical compound, silicate of iron, or ferruginous glass.

We are certain of these several facts by the silex having become soluble in the acids, undecomposed silex being perfectly insoluble therein, while the decomposition and recomposition of two of the hardest substances in nature being accomplished in less than any appreciable time, by means only of forcible approximation or concussion, whereby intense nascent heat, light, and magnetism were evolved, and at the same instant the great tenacity of the substances was nearly destroyed; and as all tenacity of gunpowder or other fulminates is wholly destroyed wherever those substances are exploded, and when heat and light is produced and expelled from such bodies, we have strong grounds for supposing that the tenacity of material substances somehow depends upon the otherwise inert elements of heat and light and magnetism, being in some intimate chemical combination with the ultimate molecules of matter in all solids.

The foregoing observations will also solve a wonderful and mysterious circumstance attending telegraphic electricity, namely, its instantaneous passage; for if metals are what they seem to be, aggregations of loose magnetic metallic atoms, retained in the solid state by being saturated with electricity, in definite atomic proportions, it plainly follows, a metallic wire is also an electric wire in a neutral state, and that the addition of electric fluid at one end of an insulated wire can only be accomplished by the emission of an equal quantity of electric fluid from the other end of wire, so that the immersion and emersion must of necessity be as instantaneous as intense.

Having seen that steel contains at least one of the electric elements, we can show that solid contains much more space therein for the imponderable elements between the atoms of ferrum, than has been hitherto stated by chemical writers, by whom it has been universally said, that all substances are expanded by heat and contracted by cold, except water when near the point of congellation, which is on the contrary so expanded by cold, that ice becomes $\frac{1}{8}$ part specifically lighter than the water from which it was formed. Notwithstanding this, it is very frequently seen in foundries, that cold cast-iron is just as much specifically lighter than fluid cast-iron, as ice is specifically lighter than water, for apparently about $\frac{1}{8}$ part of the solid floats above the surface of the fluid iron, and therefore the solid iron must contain or consist of $\frac{1}{10}$ part interstitial space, for the reception of the imponderable elements we have shown it to possess beyond any other we know not of; but which are probably very extensive from contemplating the state of fluidity in which the greater density is observed.

Here then we have seen enough to conclude that steel and silex are mere exhibitions of all and only the elements of gases in a peculiar state of condensation, containing in their interstitial spaces all the imponderable elements necessary for their conversion to the gaseous state; but if we consider these imponderable elements have been hitherto merely termed latent heat, that term must now appear most puerile and imperfect, for we cannot help allowing that at least three distinct elements are required to account for the facts observed, namely, heat, light, and magnetic force.

That heat and light are distinct elements is so easily shown by holding a pane of glass before a bright fire, whereby all the heat is stopped, while the light is transmitted. Again, that a most active and intense magnetic force exists, as distinct from heat and light, as are those properties distinct from each other, must be apparent to those who will consider how abundant and energetic must have been the force that could attract innumerable atoms of matter from their original distant positions in flint and steel, and conduct and re-arrange them accurately in their new proximations in silicate of iron, and in less than any appreciable time. Again, when light is observed separated in the spectrum, it is hardly possible to conceive that light is not a compound of more simple elements. To be satisfied then that latent heat can be a sufficient cause for, or explanation of, the distinct phenomena, to be observed in operating upon minute fragments of flint and steel, must be discreditable to the humblest intellect.

That heat possesses such a greater power of expanding the compound water, than it does of expanding the elements of water, is by no means a solitary example of the greater efficiency of heat when acting on compounds than when acting upon the elements of those compounds. We may first point to solder, which fuses far below tin, and much farther below the average of its elements, tin and lead, and a still more striking instance is afforded by fusible metal:—

		of Specific Gravity.	and Fusible Points.
Bismuth	1	9·88	476°
Bismuth	1	9·88	476°
Lead	1	11·35	612°
Tin	1	7·29	442°
		4)38·40	4)2006°
		9·60	501°

Average specific gravity 9·53 and melting points 208° were carefully found by experiment.

Having thus shown the insufficiency of any known theory to account for the wonderful properties of heat, light, and magnetism, for the purpose of explaining to the best of our ability the new and useful facts we have disclosed, and which some conceited bookworms have affected to doubt, because it is so contrary to the books from which they have derived all their information, we shall proceed to discuss the subject, and prove our position by other facts.

Brooklyn, New York. JAMES FROST.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

FEBRUARY 25, 1851.

WILLIAM CUBITT, ESQ., PRESIDENT, IN THE CHAIR.

The paper read was "A Description of the 'Royal Border Bridge,' erected over the River Tweed, on the line of the York, Newcastle, and Berwick Railway," by Mr. G. B. Bruce, M. Inst. C.E.

This viaduct, the total length of which was 2,160 feet, and the extreme height 129 feet, consisted of twenty-eight semicircular arches, each 61 feet 6 inches span; and the whole constructed of stone, with the exception of the inner part of the arches, which was of brick laid in cement. It was divided into two parts by a central abutment, which enabled the land arches to be completed, and, along with a temporary timber bridge, to be brought into use for public traffic, before the completion of the river arches, which necessarily occupied a considerable period in execution, owing partly to very substantial coffer-dams having been requisite for the river piers; but principally to its having been thought advisable to pile the foundations of most of those piers, as the bed of the river was liable to be scoured away by the rapid stream. The piles, both of the coffer-dams and of the foundations, were mostly of American elm, as it was found that the heads of the memel piles required to be frequently cut off and re-hooped, when driven by Nasmyth's steam pile-driver, which was almost entirely used, both on account of expedition and of economy; for it was proved, that whilst the hand-ram only gave one blow in four minutes, the steam pile-driver gave sixty blows in one minute, and that the cost of the former was two shillings per lineal foot, whereas that of the latter was very little more than one shilling per lineal foot. It was also remarked, that the force was more advantageously employed in the case of the steam pile-driver, as, on account of the ram being heavier and the fall less, the piles were not so frequently split.

The piers had an ashlar facing, and were filled in with well-grouted rubble, having occasional through courses of ashlar, and an ashlar tie in the centre of their width from top to bottom. Great care was taken in the preparation of the mortar and the grout used in this work, and after a variety of experiments the plan finally adopted was,—in the case of setting lime for ashlar,—to grind quicklime dry by itself, in a common mill, and then to mix it with coarse sharp sand, screened out of gravel taken from the bed of the river, in the proportion of three of sand to one of quicklime; this was then put under cover until required. Lime to be used for grout was also ground dry, and along with it was ground slag from an iron furnace, then gravel from the river was mixed with it without being screened, the proportions being, quick lime one, slag three-quarters, and gravel two and a quarter. The mortar when used had absorbed a sufficient quantity of moisture from the atmosphere and the sand, to prevent its being too hot for use, and yet, as it had not been previously mixed with water and wrought into a paste, it retained its original setting power. This mortar required to be used very soft, and the stones to be well wetted, and as the sand was very coarse, thick joints were necessary, but in a few weeks it set as hard as Roman cement. All the lime used in this work was from the mountain limestone of the Scremerston and Lowich districts of Northumberland.

The centres, which were stated to have been of peculiar construction, were supported entirely from the piers, so as to prevent any accident happening, if the scaffolding was injured, either by the heavy floods of ice to which the river Tweed is subject in winter, or from the vibration caused by passing trains; as, when the idea was first entertained of having a temporary bridge, the intention was merely to add to the contractors' scaffolding, and to make it serve for both purposes. This intention was, however, abandoned, and an entirely separate timber bridge was erected, on the east side of the stone bridge, at a cost of £14,340.

The total cost of the "Royal Border Bridge" was £120,000, and of the whole contract, one mile in length, in which it was comprised, £207,000, including an embankment, which had to be made entirely from side cutting, and which contained probably 760,000 cubic yards.

Some valuable and interesting experiments and observations were given on the velocity and regimen of the river Tweed, and the results compared with the theories generally laid down relative to running waters, by Buat and Eytelwein; and it appeared, that although both approximated closely to actual experiment, Buat's formula gave the best result.

MARCH 4, 1851.

In the renewed discussion upon Mr. Bruce's paper, descriptive of the "Royal Border Bridge," at Berwick, the question was raised, as to the propriety of using ashlar and rubble, in combination, for works of this nature. Some of the speakers considered that it was preferable to use either the one or the other alone, to prevent unequal settlement, from the different character of the two kinds of work; and instances were cited of the piers of large viaducts having been entirely constructed of rubble, with the most perfect success. On the other hand it was urged, that if in quarrying stone those blocks only were used which were suitable for ashlar work, much waste would arise and great extra expense be incurred; also, that in the piers of the "Royal Border Bridge," the back of the casing of ashlar was vertical, so that although externally the piers had offsets, the internal face of the ashlar did not follow that line, and therefore none of the weight which the ashlar ought to bear was brought upon the rubble. It was thought that good rubble, formed of large flat-bedded stones, well bonded, and set in good mortar, was preferable for dock walls, or in other situations where a head of water had to be supported, or lateral pressure sustained; but that ashlar was better adapted for bearing vertical pressure or weight, as in the piers of a viaduct. An important question was raised, as to what weight various kinds of stone were capable of sustaining without crushing, and also what weight could be placed with safety on different kinds of artificial foundations; and the discussion was adjourned for further information on these points.

SOCIETY OF ARTS.

T. M. GIBSON, ESQ., M.P., VICE-PRESIDENT, IN THE CHAIR.

DEC. 11, 1850.

"On the Different Methods of Bleaching Flax, Cotton, Linen, Calico, and other Fibres and Fabrics."—(Continued from page 20.)

The bleaching of linen is materially different to that of cotton, owing to the nature of the fibres, and of the organic substances which unite them being different, and that still greater care must be taken by the bleacher to employ such means as will remove the resins and gum which unite the colouring matter to the fibre, without altering those which unite the minute tubes constituting the real fibre; and he arrives at this, the real end of his art, by employing milder means, and almost entirely avoiding bleaching agents, which, even when employed with great care, are in danger of injuring the fibres.

"The process consists in steeping the linen in cold water for several hours, after which it is boiled in a weak solution of carbonate of soda, or with a partly caustic lye, to which is added gum fust. After twelve hours' boil under a slight pressure in the above fluid, indicating 1° or 2° Twaddel (or of sp. gr. ·02), it is well washed, and then spread out during five or eight days on the grass. After two or three such treatments, the linen, together with a thick soap-lather, is passed between two pieces of wood moving in alternate horizontal directions, called rubbing boards. Then, after another boil and exposure, it is dipped for twelve hours in a solution of vitriol indicating 1° Twaddel. It is then boiled, rubbed, again exposed, and lastly undergoes immersion for several hours in a very weak solution of bleaching liquor. The operations are as follow:—

1. Steep twelve hours in cold water.	10. Wash.	23. Wash.
2. The whole is then carried to the boil.	11. Expose on grass.	24. Expose.
3. Wash.	12. Steep in sulphuric acid of sp. gr. 1·02.	25. Acid.
4. Boil 12 hours in carbon. of soda, caustic lye, or resin soap.	13. Wash.	26. Acid.
5. Expose on grass for four to eight days.	14. Boil.	27. Bleaching liquor.
6. Boil, as before.	15. Expose.	28. Wash.
7. Wash.	16. Scald.	29. Scald.
8. Expose, as before.	17. Rub.	30. Wash.
9. Boil.	18. Wash.	31. Expose.
	19. Expose two to four days.	32. Acid.
	20. Scald with soap.	33. Wash.
	21. Wash.	34. Bleaching liquor.
	22. Rub.	35. Wash.
		36. Dry.

In bleaching, linen loses 18 per cent. of matter soluble in alkali, and from 28 to 30 per cent. of its weight during its change from a brown to a white cloth. Calico contains 5 per cent. of substances susceptible of being dissolved by alkalies, and loses in bleaching about 28 per cent. in weight.

This process occupies about six weeks in summer, and three months in winter. But I have had the good fortune, after long trials, to arrive at a means whereby I can bleach linen in three or four weeks, without, in the slightest degree, injuring the fibres, as is proved in the working of the process on a large scale in Ireland.

During the exposure on grass, the oxygen of the air appears to act on the colouring matters by removing their hydrogen, converting them into substances similar to acids, and therefore more soluble in alkalies. This is borne out by the fact, that dew or snow, which contain air, and are very rich in oxygen, help very materially the bleaching of linen. There is also no doubt that the oxygen converts the fatty matters into fatty acids, which are easily removed from the cloth as soluble soaps.

In the bleaching of linen, it is more important than in that of calico, that, after each boil or dip, the cloth should be perfectly freed from all trace of the substance composing the liquor. With this view a great variety of machines is employed; but those which are preferred are the dash-wheel, fly-winches, and Robinson's new patent washing-machine; in Ireland, generally, the old system of washing is used.

I have intentionally omitted entering into any details concerning Mr. Donlan's dry process for rating flax, finding that contradictory reports have been published as to its merits; and moreover, that the opinion of the Society for the Promotion of the Growth of Flax seems unfavourable towards it. Moreover, I was not able to obtain samples for inspection.

I succeeded in finding, several years since, a very simple process for bleaching Jute and China grass. The samples now before you show the beauty of these two fibres, and the useful applications which may be expected from the beautiful and silky appearance of the China grass, in fact, Messrs. Marshalls, of Leeds, are spinning large quantities of it.

MONTHLY NOTES.

Screw Propellers.—Cannot the Institute throw some real practical light on this subject, viz., What is the best form of propeller? Should it have six, four, three, or two blades? Which is the best angle? Should they be run at high or low speed? There are at least a dozen different patents, but none of them settle these points. What proportion should the propelling surface of the propeller bear to the immersed midship section of the vessel? At present, scarcely any two propellers are built alike; constant changes are made without *apparently* affecting the result. Are they all right, or all wrong?—H.—*Franklin Journal.*

Rich's American Cast-Iron Beam Plough.—We have received from America, sketches of several improved ploughs, made by Messrs. Bosworth, Rich, & Co., of Troy, New York. The advantages contended for in Mr. Rich's inventions are—first, the prevention of choking, due to the peculiar shape of the beam; second, the shortness of the beam brings the team nearer to the work, affording a great improvement in point of draught, ease in working, and driving the team; and third, the capability of attaching different mould-boards, to suit it to different soils and varieties of work. The inventor has modified his principle to suit various kinds of ploughs—amongst the rest, for sub-soil and hill-side ploughs.

Balloting Machines.—At a recent meeting of the Society of Arts, two machines of this class were brought forward. One has been patented by Mr. Chamberlain. This machine registers, on separate concealed dials, the votes given to particular candidates. It also registers for every vote given to a particular candidate one vote on an open dial. The votes are given by pulling levers opposite to the names of the candidates; at the same time a bell sounds, without which no vote can have been given or register have taken place. Any attempt to pull two levers at one time locks the machine altogether. Any lever having been partially pulled, must be made to produce its full and proper effect, before any other use of the machine can be made; so that having once commenced an operation, it must be completed. The number of candidates having been fixed, the machine is set so that only that number of levers can be pulled without calling into action the self-adjusting power of the instrument. This power, on the retirement of one voter, readjusts the instrument for the reception of a fresh one. There is a lever called the "plumper" or "nobody's lever," by which the voter is enabled to vote in perfect secrecy; for, although the number of levers pulled is indicated on the public dial, when this lever is used it is impossible to tell whether a vote has or has not been given. The second is the invention of M. Debain, and is used for the votes of the deputies in the French National Assembly. Each deputy is furnished with a certain number of billets or metal tickets, inscribed with his name and that of his constituency; the affirmative and negative billets are of different colours, and are formed with openings or wards, differing in each. The box has two embouchures, corresponding with the billets both in colour and in the formation of their wards or openings; thus the affirmative opening is at a glance distinguished from the negative one, while the entrance of a billet into the wrong embouchure is impossible. After passing the embouchures, the billets drop to the bottom of the box, their inscribed sides lying outwards. When all the votes have been given, the outside case is removed, and the names can be at once registered. The billets being all of the same thickness, a scale engraved on the side of the box enables their number to be quickly read.

White and Grant's Safety Cage for Mines.—This invention, lately described and illustrated in the *Practical Mechanic's Journal*,* is now in active operation in various parts of the country—upwards of 50 cages having been fitted up with the safety apparatus. Our readers will remember that in it, provision is made for the prevention of accidents, whether arising from the fracture of the rope, or from "overwinding." So far, no case of direct fracture of the winding-rope has occurred to test the capabilities of the apparatus; but several instances of overwinding have been rendered harmless by it. A few days ago, at Barleith Colliery, near Kilmarnock, when the engine was pumping, with the winding-shaft out of gear, a very decided test was accidentally brought about. In the arrangement at this pit, it is necessary to keep a loaded hutch on the cage at the pit mouth, otherwise the weight of the rope in the other shaft would overdraw the empty cage. By inadvertence the load was removed, and but for the operation of the safety apparatus, the pumping or winding shaft, or both, would have been broken—the gearing having only just been set to work after breakage by a similar accident. Mr. Ainsworth, of the Cleator Iron Company, Whitehaven, states, that at one of the pits under his charge, where the distance from the pit head to the pulleys is short, accidents from overwinding were by no means unfrequent. Since the application of the new apparatus, the cages have been repeatedly drawn up to, but never over the pulleys. It is satisfactory to learn that so simple a means of safety is now within the reach of all colliery owners.

* Parts 32 and 33, Vol. III.

Grapel's Gutta Percha Waterproofing and Coating Fluid.—One of the recent uses, and certainly a very important one, to which the new gum, gutta percha, has been applied, is the preparation of the damp walls of houses for the prevention of the exuding of moisture upon the paper or paint employed to adorn such surfaces. This protective coating is the patented invention of M. Ernst Grapel, of Birmingham, who has introduced it most successfully during the past year. In treating damp walls, whether in new or old buildings, any old paper or paint is first well cleared off, and the coating is then laid on in a slight heated fluid state with a brush, the gutta percha being alloyed, to a certain extent, with caoutchouc. This coating dries in two days, and may then be painted or papered over, without the risk of injury from any moisture. No "priming" is required in painting woodwork, as the composition is sufficiently effectual in itself. This covering is cheap, easily applied, and will soon find out for itself a vast variety of applications.

Patent Law Reform.—Proposed Bills.—The agitation for patent law reform, consequent upon the execution of the Exhibition project, is still working. First we had the unlucky *Provisional Registration Act;* then, to mend its unfortunate errors, came the *Protection of Inventions Act;* and now we have two bills, proposed by Lord Brougham and Earl Granville respectively. The *Protection of Inventions Act* simply provides that any new invention, provisionally registered during the year 1851, may be afterwards patented. In Lord Brougham's bill it is proposed that the Lord Chancellor, the Master of the Rolls, the Attorney and Solicitor-General for England, the Lord Advocate and Solicitor-General for Scotland, and the Attorney-General for Ireland, shall be Commissioners of Patents; that the petition shall be left at the Great Seal office—the grant to bear date on the day of recording such petition, the report upon which must be accompanied by descriptive particulars of the invention: one patent to cover the United Kingdom. The fees payable at the Great Seal, to be £10 on leaving petition, £8 on the royal warrant, and £2 on filing the specification. Stamps, £10 on original grant, £40 at the expiration of the third year, and £70 at the end of seven years. In Earl Granville's scheme the grant is limited to three months from report; but in general details it strongly resembles Lord Brougham's act, as well in routine as in fees. Clause 13, however, provides that an inventor may obtain a provisional patent for six months on payment of £2, and for a further term of like duration on payment of £20. In our next issue we shall have something more explicit to say in reference to the talked-of reforms.

ENGLISH PATENTS.

Sealed from 24th March, to 17th April, 1851.

Matthew Herring, Tonbridge-place, London, sugar-planter,—"Improvements in the manufacture of sugar and rum, part of which improvements are applicable to evaporation generally."—March 24th.

Frederick William Mowbray, borough of Leicester, gentleman,—"Improvements in machinery for weaving."—24th.

George Guthrie, Appleby, chamberlain to the Earl of Stair, and residing at Rephad, by Stranraer, Wigtown,—"Improvements in machinery for digging, tilling, or working land."—24th.

Thomas Hill, Langside-cottage, Glasgow, Esq.,—"Improvements in wrought iron or malleable iron railway chairs."—(Being a communication.)—24th.

Peter Armand Le Comte de Fontainemoreau, 24 Boulevard Poissonnière, Paris, France, and 4 South-street, Finsbury, patent agent,—"Certain improvements in mills for grinding wheat and other grain."—(Being a communication.)—24th.

Henri et Alexandre Six, Wazaume les Lille, temporary of Paris, France, gentleman, —"Improvements in bleaching flax and hemp."—24th.

Hector Ledru, 28 Faubourg Poissonnière, Paris, France, civil engineer,—"Improvements in heating."—24th.

James Cheetham, jun., Chadderton, near Oldham, Lancaster, cotton manufacturer,—"Certain improvements in the manufacture of bleached, coloured, or party-coloured threads or yarns."—24th.

David Farrar Bower, Hemslet, York, manufacturing chemist,—"Certain improvements in preparing, rating (otherwise called rotting), and fermenting flax, hine, grasses, and other fibrous vegetable substances."—24th.

Edward Dunn, New York, United States, America, but now residing at Montpelier-square, Brompton, master mariner,—"Improvements in reciprocating and rotary fluid meters."—(Being a communication.)—24th.

Samuel Holt, Stockport, Chester, manager,—"Certain improvements in the manufacture of textile fabrics."—24th.

Samuel Walker, jun., Birmingham, manufacturer,—"A certain improvement or certain improvements in the manufacture of metallic tubes."—24th.

Thomas Hawkins, Inverness-terrace, Bishop's-road, Bayswater, oilman,—"Improvements in brushes."—24th.

Henry Stephen Ridley, Vincent-square, Westminster, surveyor, and James Edser, St. James's-terrace, in the said city, builder,—"A safety hinge and certain apparatus for the detection of burglars and prevention of burglaries."—24th.

Thomas Woods, Portsea, Hants, upholsterer, and Robert Walter Winfield, Birmingham, Warwick, manufacturer,—"Certain improvements in bedsteads and couches, or articles for sitting, lying, and reclining upon."—24th.

John Gwynne, Lansdowne-lodge, Notting-hill, Middlesex, merchant,—"Improvements in machinery for pumping, forcing, and exhausting of steam, fluids, and gases, and in the adaptation thereof to producing motion to the saturation, separation, and decomposition of substances."—(Being a communication.)—31st.

John Peter Booth, Cork, Ireland, feather purifier,—For an improved manufacture of fabric applicable to the construction of muffs, boas, tippets, and other like articles, and also to the ornamenting of articles of dress and furniture, and other similar uses."—31st.

Louis Brunier, Paris, civil engineer,—"Improvements in obtaining power by the use of steam or compressed air."—31st.

Joseph Richardson, Halifax, York, dyer,—"Improvements in dyeing and cleansing piece goods."—31st.

Auguste Motte, Southwark, Surrey, manufacturer,—"Certain improvements in portmanteaus."—April 2d.

Thomas Huckvale, Choice-hill, Oxford,—"Improvements in treating mangel-wurzel, and in making drinks and other preparations therefrom."—2d.

Richard Archibald Brooman, of the firm of Messrs. J. C. Robertson & Co., Fleet-street, London, patent agents,—"Improvements in machinery for the manufacture of rope and cordage."—(Being a communication.)—2d.

William Barker, Hulme, near Manchester, millwright,—"Improvements in machinery for chipping, rasping, and shaving dyewood, and other materials, and in apparatus connected therewith."—7th.

Christopher Cross, Farnworth, near Bolton, Lancaster, cotton-spinner and manufacturer,—"Certain improvements in the manufacture of textile fabrics, and in the manufacture of wearing apparel from textile materials."—8th.

John George Appold, Finsbury-square, gentleman,—"Improvements in machinery for regulating and ascertaining the labour performed by manual or other power."—9th.

Charles M'Dowall, Hide-street, Bloomsbury, Middlesex, watchmaker,—"Certain improvements in the construction of time-keepers."—10th.

Henry John Betjemann, Upper Ashby-street, Northampton-square, Middlesex,—"Improvements in connecting parts of bedsteads and other frames, and in machinery employed therein."—15th.

Frederick William East, of the firm of Thomas East and Son, Bermondsey, leather-dressers,—"Improvements in dressing, embossing, and ornamenting leather."—15th.

Benson Stones, Warwick-street, Golden-square, Middlesex,—"Improvements in the use and treatment of peat and its products, and other carbonaceous matters; and also for apparatus applicable to such and other chemical purposes."—15th.

Herman Schroder, Bristol, gentleman,—"Improvements in manufacturing and refining sugar."—15th.

Antoine Victor Coutant, Paris, France, iron-master,—"An improved mode of partially hardening iron for various purposes."—15th.

Thomas Greaves Barlow, Bucklersbury, London, civil and consulting gas engineer, and Samuel Gore, Park-road, Old Kent-road, engineer,—"Improvements in the treatment of certain substances used in the production of gas for giving light and heat, and of some of the products of the said substances, as also in the apparatus employed in the manufacture of such gas, and in discharging and giving motion to gas."—15th.

Charles Hardy, Low-moor, York, engineer,—"Certain improvements in the manufacture of scythes."—15th.

Robert Newell, New York, United States, America, lock manufacturer, and a citizen of the said States,—"Certain new and useful improvements in the construction of locks."—15th.

Frederick Puckridge, Kingsland-place, Middlesex, merchant,—"Improvements in the preparation or manufacture of materials or fabrics suitable for ornamenting furniture and other articles."—17th.

Thomas Keely, Nottingham, manufacturer, and William Wilkinson, of the same place, framework-knitter,—"Improvements in machinery for manufacturing textile and woven fabrics, and other articles composed of fibrous or filamentous materials; also for improvements in the said fabrics and articles."—17th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 20th March, to 15th April, 1851.

Mar. 20th	2736.	G. Wilkin, Alnwick,—"Self-acting water-closet."
—	2737.	J. M. Turner, Norwich,—"Corne's universal plough."
—	2738.	J. Dyke, Ipswich,—"Portable cooking apparatus convertible into a close or open stove."
21st,	2739.	A. Graham, Glasgow,—"Gas cooking-range."
—	2740.	S. Scafe, York,—"Spur spiral winder."
24th,	2741.	Newbould and Baildon, Sheffield,—"Balance table-knife."
25th,	2742.	L. Foucart, M.D., Glasgow, and St. James's-square, London,—"Chest expander or spinal rectifier."
26th,	2743.	D. & G. Greig, Edinburgh,—"Self-acting guage for side-lever lithographic press."
—	2744.	J. Hynam, Princes-square, Finsbury,—"Safety-lid to a vertical square match-box."
27th,	2745.	Perkins and Sharpus, Bell-court, Cannon-street,—"Double cone smoke elevator for curing smoky chimneys."
—	2746.	G. R. Woolgar, Wood-street, Cheapside,—"La jumelle scarf cravat."
28th,	2747.	Edward Shingler, Birmingham,—"Sporting boot."
—	2748.	Garton and Jarvis, High-street, Exeter,—"Convolute boiler for heating hot-houses, conservatories, public and other buildings, by steam or hot water circulating through pipes."
—	2749.	Blackwood & Co., Long-acre,—"Ready reference file."
29th,	2750.	L. Silberberg, Fleet-street, and St. Martin's-le-Grand,—"Askopsolon cigar-case."
—	2751.	George Ellwood, Aldersgate-street,—"Expanding fur-cuff."
31st,	2752.	Stock and Son, Birmingham,—"Tap."
—	2753.	Tylor and Sons, Warwick-lane, Newgate-street,—"Bath."
—	2754.	George Dible Beckett, Fenchurch-street, and Gracechurch-street,—"Boot."
April 1st,	2755.	Richard Milliard, Craven-street, Strand,—"Portmanteau bag."
—	2756.	D. Hulett, High Holborn,—"Compound concentric gas-burner."
2d,	2757.	Alfred Richard Corpe, King-street, St. James',—"Fastening for trowser-straps."
—	2758.	Peter R. Jackson, Salford,—"Safety-cap for steam-boilers."
—	2759.	Isham Baggs and James William Giles, Aldersgate-street,—"Fire and burglary alarm."
—	2760.	Robert Plummer, Newcastle-on-Tyne,—"Flax straw-breaking machine."
—	2761.	J. Coate & Co., Brewer-street, Golden-square,—"Anti-carious tooth brush."
3d,	2762.	Joseph Haley, Manchester,—"Safety-signal for steam-boilers."
—	2763.	Huxley, Heriot, & Co., Castle-street, Long-acre,—"Iris reading and copying-press."
4th,	2764.	James Wodderspoon, Portugal-street,—"Sectional strengthening account-book and index band."
7th,	2765.	George Stephens, Brownlow-street, Drury-lane,—"Compound elliptic spring."
8th,	2766.	Robert Brown, Edinburgh,—"Torch and valve for lighting road signals and other lamps on railways."
—	2767.	Hodges and Son, Dublin,—"Safety tea-kettle."
10th,	2768.	G. Cooper, Sheffield,—"The Venetian chimney top."
—	2769.	R. Dark, Burlington Arcade,—"Collar fastener."
—	2770.	J. Wilson and Sons, Wigmore-street, London,—"Manifold revolving table top."
—	2771.	H. Martin and J. Smethurst, Hyde, Chester,—"Apparatus for planing the seatings and faces for slide-valves of steam-engines."
April 10th,	2772.	C. Robinson, Greenland-place, Brunswick-square,—"Telescopic military bedstead."
11th,	2773.	C. Hart, Wantage, Berks,—"Universal mill."
12th,	2774.	W. Palmer, Brighton,—"Perforated ventilator (window)."
—	2775.	B. Poulson & Co., Quadrant, Regent-street,—"Pardessus and Cantab walking coats."
—	2776.	T. Whimster, North Port, Perth,—"Improvements in the wet gas-meter."
15th,	2777.	H., J., and D. Nicoll, Regent-street,—"Coat."
—	2778.	J. Nasmyth, Patricroft, Lancashire,—"Safety-valve for boilers and generators."
—	2779.	Ainge and Aldred, Oxford-street,—"Telescope landing handle for fishing."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 22d March, to 15th April, 1851.

Mar. 22d,	112.	O. Oliver, John-street, Tottenham-court road,—"Chimney-pot."
—	113.	W. T. Denham, Charles-street, City-road,—"Rosin-box."
24th,	114.	G. Jacobs, Cockspur-street,—"Stranger's Guide to London."
26th,	115.	J. Gedge, Wellington-street, Strand,—"Safety lock and key."
—	116.	W. Ladd, Penton-place, Walworth,—"Adjustments for microscopes."
—	117.	W. Green, Richmond-road, Islington,—"Ventilator."
27th,	118.	Gregory Kane, Dublin,—"Portmanteau buckle."
28th,	119.	Thomas Allen, Clifton,—"Iron roof."
—	120.	Richard Wesson, Coburg-street, Hampstead-road,—"Secret lock."
29th,	121.	Etienne de Maignol Mataplane, South-street, Finsbury,—"Circular tilting platform."
—	122.	Edward Golding, Hurstbourne Priors, Andover-road,—"Rolling barley chumper."
31st,	123.	Michel Roch, South-street, Finsbury,—"Letter envelope."
—	124.	John Freeman, Wigmore-street,—"Napoleon cafetière."
—	125.	Edward Hughes, Stockbridge-terrace, Pimlico,—"Self-adjusting lamp."
April 1st,	126.	Nosophore Rabiot, South-street, Finsbury,—"Invalid bedstead."
2d,	127.	Michel Roch, South-street, Finsbury,—"Letter envelope."
—	128.	John L. Fry, Honiton,—"Tailor's cardinal point, measure, and rule."
—	129.	Giles Little & Co., Fetter-lane, and Cursitor-street,—"Ring for fishing-rods and other purposes."
—	130.	Samuel Jackson, Red Lion-street,—"Illuminated candle clock."
3d,	131.	James Adcock, Shaldon, Teignmouth,—"Comparative scale of the diameter and quadrant of a circle."
—	132.	Thomas Holland, South Audley-street,—"Boiler-cock."
4th,	133.	John Gedge, South Wellington-street, Strand,—"Close joints for water, gas, or other pipes."
—	134.	Michel Roch, South-street, Finsbury,—"Letter envelope."
7th,	135.	Edward Hill & Co., Dudley,—"Expanding horse hoe."
—	136.	Mary Mason, Newcastle-under-Lyne,—"The Crighton."
8th,	137.	John Brady, Blackfriars-road,—"Safety riding-belt."
—	138.	E. R. Turner & Co., Ipswich,—"Feed-regulator for steam-boilers."
—	139.	John Hazleton, Salisbury-street, Lisson-grove,—"Safety screw cork."
9th,	140.	A. S. Stocker, Wandsworth,—"Metallic embossed casket."
—	141.	E. A. Baker, Whitechapel-road,—"Gun-lock."
—	142.	R. C. Mansell, Ashford,—"Tyres for railway and other wheels"
—	143.	
—	144.	
—	145.	
—	146.	William Collimore, Whitechapel-road,—"Traveller's indispensable."
—	147.	J. R. Isaac, Liverpool,—"Manifold stand."
—	148.	J. A. Deveria, Calthorpe-street,—"Beacon advertiser."
10th,	149.	T. Hodges, Oxford-street,—"The Demopodeion."
—	150.	J. E. Boyd, Lower Thames-street,—"Double action or self-adjusting scythe."
—	151.	W. Hughes, Manchester,—"Typograph for the blind."
—	152.	M. Roch, South-street, Finsbury,—"Letter envelope."
—	153.	M. Roch, South-street, Finsbury,—"Letter envelope."
—	154.	E. Jackson, Stockwell,—"Measuring telescope."
11th,	155.	E. Huxtable, Hinton, near Chippenham,—"Floating-wheel.'
—	156.	W. H. Dupré, Jersey,—"Wind guard."
12th,	157.	H. Bell, Millbank,—"Balloon valve."
—	158.	H. Stoy, Lambeth,—"Railway brake or stop."
—	159.	W. and J. Harcourt, Birmingham,—"The Vesta union vase."
—	160.	W. N. Crips, Hockley-hill, and W. Dugard, Jun., Birmingham,—"Railway tender and carriage."
—	161.	Paul and Eves, Birmingham,—"Metallic fitting for lasts and boot trees."
14th,	162.	W. T. Monzani, Bermondsey,—"Folding tents."
15th,	163.	J. Fiddler and J. Ramsbottom, Derbyshire,—"Water meter."
—	164.	J. Rigmaiden, Lieutenant, R.N., Regent's-park,—"Lanyard plates for setting up standing rigging."

TO READERS AND CORRESPONDENTS.

Books Received.—"Chalmers on Electricity." "Spence on Patentable Invention and Scientific Evidence."

No. 7, London.—His communication will be attended to next month. We are obliged by his attention.

W. C. S.—We are afraid we do not rightly comprehend his query. Is it the most effective *form* of float, that he wishes to know? If so, see the several articles in the recent numbers of this Journal, "On the Propulsion of Steamers."

C. T., Merthyr.—We intend to furnish some particulars of the paper shortly. We are not at present in possession of drawings to accompany it. Whether we can give it *in extenso*, or whether we can give the necessary illustrations, is yet to be considered. We are afraid tracings will not be attainable. Their appearance in the transactions is a matter of uncertainty.

J. D., Beds.—We shall have much pleasure in assisting his views, when opportunity offers.

A. D. B., Clinton, U. S.—We shall be glad to have particulars of the invention at any time. Meanwhile, his proposition requires consideration.

J. G., Norfolk.—We have replied to him by letter. If he requires any further information, we shall be glad to hear from him.

B. R. & Co., Troy, U. S.—If we hear of anything suitable, we shall communicate with them. Meanwhile, we have made some slight use of the particulars sent us.

E. L., Manchester.—We are engraving the views for our next issue.

A. M., Dundee.—We cannot find space for the particulars here, but will communicate them by letter, if he wishes us to procure them.

THE GREAT EXHIBITION.

"In Eastern tales we read, how in one night
A gorgeous palace grew by magic might,
A solid pile of Iris-tinted light."—HARTLEY COLERIDGE.

"In our days, an increasing knowledge of the mutual relation of phenomena, leading to the attainment of general results, has more than kept pace with the vast increase of separate observations. The chasms which divide facts from each other are rapidly filling up; and it has often happened, that facts observed at a distance have thrown a new and unexpected light on others nearer home, which had long seemed to resist all efforts at explanation."—ALEXANDER VON HUMBOLDT.

With Thursday, the 1st of May, in the year of grace, one thousand eight hundred and fifty-one, came the happy consummation of the grand project to which we have so long looked forward. On that bright morn, the smiling heavens looked down upon a peaceful "gathering of the nations,"—a parallel to which is "nowhere to be found in all the hoary registers of time."

Streams of golden light from May-day's sunny hours, imbued the glassy pile with fairy splendour, giving meet welcome to this climax of our toil. Everything gave token of success, all misgivings vanished, and the echo of past doubting murmurs died with the opening pageant.

By the time this page reaches our readers, the most distant of them all will have been made acquainted with the details of the grand ceremonial, compared to which, whether as regards its immediate impressions, or the more dimly-defined social results shadowed forth in its train, the splendour of all previous human displays grows pale, and their pomp sinks into insignificance. The pages of ancient and modern history, or the unwritten legends of all time, alike fail to recall to us aught so glorious—not e'en the more than human magnificence of Scheherezade tells us of aught so wondrous—as the Exhibition of the Industry of all Nations in 1851.

The vast iron-pillared roof of glass, is in itself a greater marvel than the wide world can elsewhere show. Unlike the majestic monuments of ancient constructive art, which swallowed up the labours of generations and untold years of time, this vast erection has been created by the efforts of some two thousand men in five months. So suddenly has it sprung into existence, that we may almost say with Hartley Coleridge—

"In one night,
A gorgeous palace grew by magic might."

Cathedral-like in plan, its eastern and western naves, divided by their towering transept arch, stretch out in long vistas of pillar, girder, and surmounting glass. But here the likeness ends. A crowd of cathedrals might be placed within it, whilst the light elegance of the whole fabric, at once impresses the beholder that he looks upon what the world ne'er saw before.

To describe the first burst of magnificence of the opening day, would demand the labours of a magic pen. Let those who were not present, picture to themselves, if they can, this glass pavilion, peopled with 25,000 human beings, fittingly attired for so splendid an occasion. Let them fancy the beauteous effect of the rows of seated ladies lining each side the royal path, like gay parterres in the first blush of summer. Let them conjure up the booming of the cannon—the initiatory trumpet blast, which made known the entry of the Queen, and the enthusiastic burst with which she was received—the pealing notes of many organs, and the sublime harmony of the attuned voices, which in hundreds gave the opening chorus—the slow procession of the brilliant court, decked out with the costumes of all climes. For all this, let them search in the realms of fancy, for we cannot furnish words to aid them. Let us see if we can individualise the building's contents.

The main entrance to the building, and that by which the visitor should certainly enter for the first time, is the central one at the south end of the transept, opposite Prince's Gate, in the Knightsbridge Road. This entrance is cleverly formed by the columns carrying the elevation of the transept, the bases having an architectural character up to the top level of the luffer boards, forming the base walls. The floor is here paved with Llangollen flagstones, which serve a very useful purpose, whilst they act as representatives of the Welsh production. From this floor, a short flight of oaken steps conducts the visitor to the level of the floor of the building, on which level are the pay-boxes of the money-takers, and the bole of one of the fine "preserved" elms. The end gallery of the transept answers as the roof of this entrance portico, and through this roof passes the elm, its branches overshadowing the floor above. A beautiful pair of gilded iron gates gives admission to the transept, where, in the centre, and commanding the entrances to both naves, stands Osler's glass fountain, which, without embodying any particularly striking outline, forms, by its material and action, a splendid centre-piece. Its height is 27 feet, and it is composed of distinct tiers of columns, grouped together to support a central shaft, the apex of which has a lipped orifice for the discharge of the water. From the cup so formed, the water falls in a flower-like sheet before separating into a beautiful spray, which is finally received by a basin of concrete, 24 feet in diameter at the fountain's base. Beyond the fountain, and in its close neighbourhood, is the elevated platform for the Queen's chair of state, surmounted at a height of 30 feet by a wide-spreading silken canopy, by Messrs. Jackson and Graham. On each side stand equestrian statues of Her Majesty and Prince Albert—spoiled, however, by being on a puny scale, less than life size. Further on, a fine pair of iron gates, by the Coalbrookdale Iron Co., separate the main body of the transept from the refreshment area, behind which is the north or royal entrance.

The transept has been aptly termed the equator of the world's gatherings. On one side, India and the colonies; and, on the other, China, Tunis, the Brazils, Persia, Arabia, Turkey, and Egypt, are grouped round it. Those who have seen the building must acknowledge that this arrangement harmonises well with its character, whilst the scheme which it involves, does away with all chance of jealousy as to the position of the nations. In the western division, next to the colonies, are placed our own productions; and immediately after the foreign states already mentioned, are placed, in the eastern division, the contributions of the chief European communities, and those of the United States. At the extreme end of the eastern nave, stands Hiram Powers' charming marble statue of the Greek slave; near it again are the spirited Stuttgard horses, modelled from Arabians in the stud of the King of Wurtemburg. The same division also comprehends, amongst its chief lions, the splendid bronze of the Amazon, by Kiss of Berlin, confessedly the finest specimen of modelling in the entire range—the Bavarian lion, by Müller—Mazeppa, and Schwanthaller's bronzes. Here also is a majestic piece of sculpture by M. Simonis of Brussels—Sir Godfrey de Bouillon. This extraordinary work is of extra-colossal dimensions. The knight is mounted on a heavy war-horse, which he has suddenly reined in, whilst he rallies his companions in arms by a wave of his flag. Near the end joining the transept is the gilded parrot's cage, containing the Koh-i-Noor diamond; and the last central object is a frame containing portraits of Her Majesty and Prince Albert, placed back to back.

Amongst the mass of things occupying the divisions on the northern side of this nave, is the suite of Austrian apartments, filled with carved furniture of rare beauty and design, and of admirable execution. For the carved bed alone, four thousand guineas has, it is said, been offered and refused. On the southern side, nearly opposite, is the Milan sculpture court, filled with some of the most magnificent examples of Italian art. The American region is strikingly bare. The principal contents are raw produce and machinery, chiefly of the agricultural class; but we must not omit a splendid collection of Daguerreotypes, many on a large scale, seldom seen in this country.

But we can now only glance at the collection: we must cross

the transept, and carry the reader into the western nave, where our home products have found a resting-place. The first compartment is devoted to East India contributions. Afterwards comes the Colonial department. Then we have the Sculpture court, Pugin's Mediæval court, and the Fine Arts court. Further on, on the south side, we have Birmingham and Sheffield hardware, and Metropolitan furniture; then a miscellaneous collection of metal manufactures—this range being terminated by woven and printed fabrics of all kinds. Outside these, again, is a vast range of agricultural implements. Opposite to the Sheffield contributions, on the north side of the nave, the machinery section commences—this class being divided into sections of "machinery in motion" and at rest. Cotton machinery in motion fills up the north-western corner, whilst alongside it, stands the carriage range.

In the nave itself, the first conspicuous object looking from the transept, is a silk trophy by Messrs. Keith & Co., from the original designs of Mr. Wallis, afterwards extended and executed by Messrs. Laugher, Dwyer, & Co. Near it, and also in the centre, is the Canadian trophy, built of varieties of timber, and surmounted by a canoe.

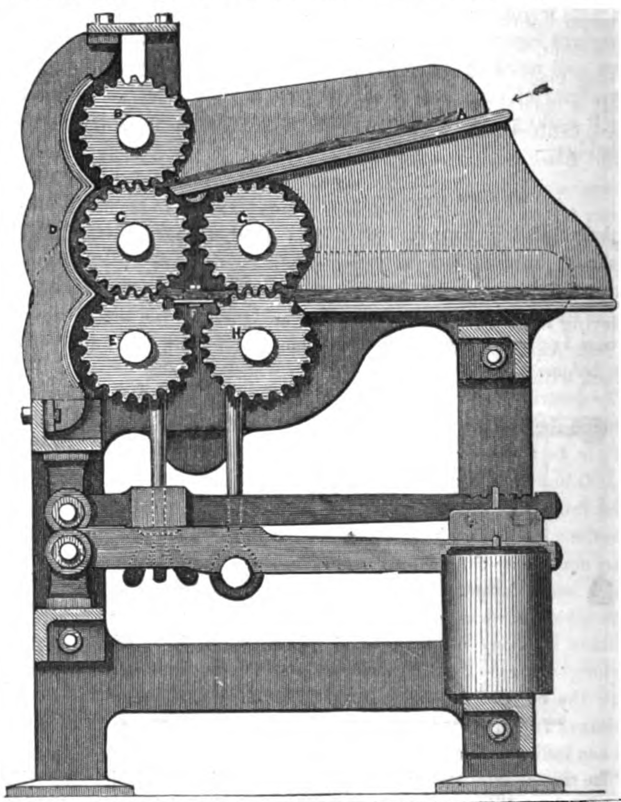
Further on is Mr. Maclean's gorgeously-framed mirror, a carved mediæval cross by Pugin, and a Gothic screen, elaborately carved by Jordan's patent machinery. Some immense pillars of various artificial crystals, examples of chemical manufactures, Mr. Dent's turret-clock, and Messrs. Rodgers' trophy of cutlery, are here ranged together. Another example of Coalbrookdale casting, a huge arborescent dome; several models of bridges, Mr. Grantham's extraordinary model of the Liverpool docks, and the "largest plate of glass in the world," complete the line of curiosities. This immense mirror is the work of the Thames Plate Glass Co., and was produced at their establishment at Bow Creek, Blackwall. In its spotless surface, is, as it were, reproduced and reflected, all the grandeur of the long-drawn nave.

We have hitherto confined our notes to the ground floor, over which we have travelled somewhere about six miles. Returning along the western nave, and so getting a second view of its contents, a staircase between Canada and the East Indies gives us access to the south gallery. Proceeding westward, we pass a wilderness of chemical manufactures, substances used as food, vegetable and animal substances, guns, naval architecture and models. At the western end, passing northwards, we reach the central south gallery, filled with philosophical instruments, brilliant ranges of jewellery, tapestry, Coventry ribbons, Spitalfields silks and hosiery, and all the varieties of shawls and clothing. Eastwards from the transept, are Lyons silks, a German organ, Switzerland's productions in straw, Massachusetts cottons, and an endless variety of articles, chiefly connected with the countries placed beneath. On crossing by the eastern end gallery, we get a glance at the French and Brussels lace, and some stained glass collected from all quarters. Passing onwards, the path lies through a selection of miscellaneous articles in the transept gallery; which, crossed at the northern end, over the royal entrance, tenanted by Messrs. Gray and Davidson's huge organ, leads us into the central north gallery, amongst pottery, glass, surgical, musical, and philosophical instruments, ending with Mr. Willis' large organ at the extreme western end. Behind the organ is a collection of naval and other models; next to which, in the north gallery, is the department of civil engineering; and in a line with this are more surgical instruments, cutlery, and animal and vegetable manufactures. This completes our mere external survey, and has added about three miles more of gallery promenade to our six miles of ground floor.

In penetrating a second time to this vast wilderness of the world's productions, we begin to single out its contents for examination. In our own department of the works of mechanism and engineering, there is ample scope for a lengthened dissertation. There may be seen in busy work, Mr. Applegath's latest example of his improved vertical cylinder printing machines. It is the property of Mr. Ingram of the *Illustrated London News*, the Exhibition supplement to which paper is printed by it in the building. This machine is similar to that employed upon the *Times*,* with the difference, that it has only four impression cylinders, instead of eight, as in the example in Printing-house Square. It is surrounded by an enclosure, wherein the visitor may inspect all the appurtenances of the printing-office. As printing of this class requires a much higher degree of accuracy than is necessary in mere newspaper type work, it is a matter of some interest to find that the inventor has been so successful in his present application of it. The wood upon which the illustrations are engraved, is curved to the radius of the type cylinder; a peculiarity which, whilst it evidently throws some obstacles in the way of the artist in making his drawings, has been cleverly worked out by Mr. Applegath. Messrs. Mather of Salford furnish an equally interesting example of printing mechanism, in their eight-colour machine for printing calicoes. This machine, which has a drying apparatus attached, presents one of the finest instances of modern mechanical excellence, in the unerring accuracy with which the "register" is kept throughout the long list of colours.

In the class of textile mechanism, Messrs. Hibbert and Platt, the eminent machinists of Oldham, are by far the most extensive contributors. It is, in fact, not too much to say, that they have actually planted an entire cotton factory within the building. In the north-west corner they have railed in an immense area, where they show us everything, from the opening "devil" for the raw material, to the interweaving loom for the finished fabric, the whole being driven by an engine erected by Messrs. Hick of Bolton, who also contribute the entire mill-gearing and framing—perfect examples of their kind. Messrs. Parr, Curtis, and Madeley, and Messrs. Cocker and Higgins, are also large exhibitors in the same department. The ingenious automatic winding machine, recently patented by Mr. T. L. Paterson, and described by us in our April part, is also here in full operation; as also is Mr. Macindoe's new patent self-acting mule, with lever action for putting up the carriage, together with an improved throstle.

In flax machinery, Messrs. Lawson, Plummer, Parker, Brown, and Crawshall, are the principal contributors. The annexed figure repre-



* See description of the *Times* machine, p. 248, Vol. I., *P. M. Journal.*

sents Mr. Plummer's registered flax-breaking machine in transverse section. In operation, the flax straw is laid upon the table A, and passed between the fluted rollers B C, the guide or back plate D, causing it to bend round the underside of the roller C, and between it and the roller E. Hence it is conveyed over the plate F, and between the rollers G and H, being finally laid out on the lower table; or, instead of this action, the reverse may be adopted, the straw being laid on the lower table, and passed out by the first table A. In its passage through, the straw is crimped and bent so as to loosen the boon, the process being repeated if necessary. Motion is given to the machine by a pulley at one end of the shaft of the bottom roller E, which gives motion to all the other rollers by toothed wheels, and an intermediate stud wheel. The ends of the rollers have plain parts turned upon them, which parts bear upon each other, so that the flutes of one roller works into the spaces of the other, leaving room for the passage of the straw.

The novelties in this machine consist in causing the straw to pass, at each operation, three times between the breaking surfaces, with a smaller number of fluted rollers than usual; and in the adoption of the guide-plate D, to compel the straw to bend round the middle roller, for the more effectual loosening of the boon.

Amongst the heavier machinery, are some fine examples of the adaptation of hollow-framing for various purposes, by Messrs. Whitworth, with which also Mr. Fairbairn's tubular crane may be classed. Messrs. Boulton and Watt have sent a pair of 700 horse-power direct-action marine engines, together with two models, one representing the first locomotive of 1785, the other a modern oscillating engine from the Soho Works. Messrs. Maudsley and Field contribute engines of the double-cylinder and annular-piston class, with a huge marine engine connecting-rod, as a specimen of their beautiful workmanship and high finish.

Messrs. Penn of Greenwich, the leading oscillating engine makers, have here well supported their reputation. They contribute—

1st. A pair of oscillating marine engines, 24 horse power, as an example of the simplicity, fewness of parts, perfect direct action, and extreme lightness. For river use, 9 cwt. to a nominal horse power is the weight, with water in the boilers. The fact of Messrs. Penn having already made more than 200 pairs of oscillating marine engines, is of itself a guarantee of their successful working. H. M. screw yacht *Fairy* is fitted with a pair of these engines, as well as the Admiralty yacht *Black Eagle*, most of the *Post-Office Packets*, and many *Men-of-War Steamers*. A pair of them is now in course of construction, of 500 horse power for the *Great Britain* steam-ship. On one side of the engines the ordinary paddle wheel is shown; on the other, the mechanical or feathering wheel; and the latter, Messrs. Penn have applied with very great success to many river and sea-going vessels, especially those carrying the Dover and Holyhead mails.

2nd. A pair of patent trunk engines, for driving the screw propeller direct, without the intervention of cog wheels. A great number of revolutions of the screw shaft per minute being necessary (the engines exhibited are intended to make 115 revolutions in that time), simplicity and few parts are absolutely required to insure success. In this arrangement it will be seen that the connecting-rod is actually joined to the piston itself, and the angular strain is taken by trunks or pipes passing out of each end of the cylinders, thereby doing away with guides, cross-heads, and other complications. The air-pumps are double acting, and are worked by a straight rod from the piston to the pump plunger. The feed pumps are also worked by the same direct application. Engines on this principle have been very successfully used in H. M. screw frigates *Arrogant* and *Encounter*, the former making 60 and the latter 80 revolutions per minute, their power being respectively 360 horses.

3rd. A model of the patent trunk engines of 360 horse power, for H. M. screw frigates *Arrogant* and *Encounter*.

4th. A model of the oscillating engines of 500 horse power, for H. M. steam-frigate *Sphynx*.

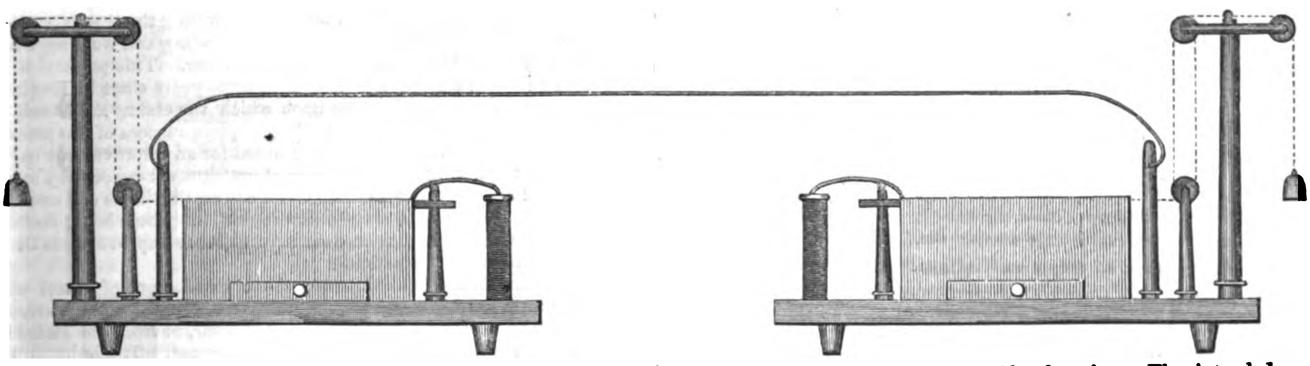
5th. A model of the engines of one of the *Watermen* Thames steamers, of 32 horse power collectively. This model shows the ordinary paddle wheel, and also the mechanical wheel, with feathering floats.

6th. A model of the screw of H. M. S. *Arrogant*.

7th. An auxiliary or feed engine, to pump water into the boilers of steam vessels when the large engines are not at work, or in case of derangement of the feed pumps. The feed engines are generally arranged in the vessels fitted by Messrs. Penn as a wash-deck, bilge-pump, and fire-engine.

Messrs. Sharp are represented by slotting and punching machines. Messrs. Donkin, by their beautifully constructed disc engine. The Bank Quay Foundry Co., Warrington, send the gigantic hydrostatic press used in elevating the tubes of the Britannia Bridge, and Mr. Appold has his simple and effective rotatory pump in full action. In locomotives, there are some dozen examples, embracing all varieties, and from various makers. Messrs. Waterlow exhibit M. Rémond's beautiful envelope folding machine, which, from a heap of cut blanks, turns out vast quantities of finished envelopes without any attendance. In this respect it contrasts very favourably with Messrs. De La Rue's more showy machine in the western nave, which possesses some beautiful movements, but involves the constant attendance of a boy to supply each individual blank.

It is impossible to pace through any single corridor of this vast collection, without feeling that the history of its contents would fill volumes. How little then can be done in these pages, in the way of placing a comprehensive view of the objects before the reader! Take, for example, the single subject of electric telegraphs. The invention is of but modern growth, and yet the Exhibition has shown us that there are in existence myriads of modifications of the original idea; we will select one, that by our correspondent Mr. R. Smith of Blackford.



In this ingenious telegraph, the same instrument answers both for receiving and transmitting the message. Our engraving represents the two terminal instruments in side elevation. The intended communication is written on paper with a metallic ink, which is a con-

ductor of electricity. The paper so written on, is placed on a board, which is constructed to slide in and out of the bottom of the instrument. Upon a leaden block, carried on the slide of the opposite instrument—which is, for the time being, the receiver at the distant station—is laid a sheet of writing paper, wetted with a chemical solution, compounded of ingredients not yet made public.

When the telegraph is put in operation, the connection is formed with a voltaic battery, and so soon as the electric current is transmitted along the wires, an electro-magnet placed on each machine becomes excited, and attracts a keeper placed above it. The movement so obtained lifts a latch, and the carriage containing a number of metallic points, in connection with the communicating wires, is liberated and drawn along the grooves of the instrument, by a weight passing over a set of pulleys. When the points are in contact with the writing, the electricity is conveyed by the wires, and decomposition takes place upon the paper of the instrument which is receiving the message, forming a series of lines. When, however, the points pass over the blank spaces between the lines of writing, the current is intercepted, and blanks result. In this way, a fac-simile of the writing is produced, the letters being black and the ground white. Similarly, types may be made to operate instead of the metallic writing, and, on this principle, a reprint of a book or newspaper may be obtained—the types being at one terminus, whilst the impression is produced at the other.

Regarded as a directly commercial speculation, the Exhibition has proved pre-eminently successful. Close upon £70,000 has been paid to the Royal Commission by the various local committees, to whose labours the scheme is so much indebted, and without whose assistance the Royal Commission itself would have been powerless. To this we have to add at least £60,000 as the produce of the sale of season tickets, whilst sums varying from £1,500 to £3,000 have since been daily received in payments at the doors.

Apart from all other and meaner considerations, we can scarcely reckon too highly upon the benefits which promise to accrue to civilization; or the better appreciation of national character, which is to be looked for from such a congress of nations.

In his May-Day Ode, dedicated to this great event, the author of "Vanity Fair" has finely said:—

The representatives of man,
Here from the far Antipodes,
And from the subject Indian seas,
In Congress meet:
From Afric and from Hindostan,
From Western continent and isle,
The envoys of her empire pile
Gifts at her feet.

Our brethren cross the Atlantic tides,
Loading the gallant decks which once
Roared a defiance to our guns
With peaceful store;
Symbol of peace, their vessel rides!
O'er English waves float Star and Stripe,
And firm their friendly anchors gripe
The father shore!

From Rhine and Danube, Rhone and Seine,
As rivers from their sources gush,
The swelling floods of nations rush,
And seaward pour:
From coast to coast in friendly chain,
With countless ships we bridge the straits,
And angry Ocean separates
Europe no more.

From Mississippi and from Nile—
From Baltic, Ganges, Bosphorus,
In England's Ark assembled thus
Are friend and guest.
Look down the mighty sunlit aisle,
And see the sumptuous banquet set,
The brotherhood of nations met
Around the feast!

And in this gathering, every nation will penetrate into, and view clearly, the true state of its brother powers. In such a repository, the leading tastes and predilections of a people must come out. In it will be solved the problem of the means by which some countries have risen almost to the highest conceivable pinnacle of civilized magnificence and splendid comfort, whilst others are sunk in the mere externals of barbaric pomp. With this key will be unlocked the mysteries of many triumphs, and the secrets of innumerable defeats. Nation will look nation in the face, and each will read in language which cannot be mistaken—the language spoken by the fruits of the world's industrial art—in what it has already conquered, and for what it has yet to strive.

III.—AN EPITOME OF AMERICAN INVENTION IN 1849.

Metallurgy.—A process for making steel, in which the chief novelty consists in using pig-iron that has been melted in contact with carbonic oxide, as a charge for the converting fire, has been patented; and likewise a process for obtaining wrought-iron direct from the ore, which differs but slightly from well-known processes; so also has been an arrangement of travelling bloomery or finery fires, that can in turn be brought under the hearth of a blast furnace. It is not known that this last device has been brought into actual use, and there would appear to be many practical difficulties in the way of its successful operation.

In the process of hammering or shingling, welding and rolling wrought-iron, letters patent have been granted for a machine, the invention of a well-known ironmaster, who has heretofore distinguished himself in improvements in his peculiar branch of industry, which promises at no distant day to make a revolution in the forge and the rolling mill, and much decrease the price and improve the quality, not only of the heaviest wrought-iron shafting, but even of the smallest rods.

This machine consists of three or more conical frusta of metal, confined in a frame, with their smaller ends downwards, in such a manner that revolution may be imparted to all of them; and the axis of each of them is arranged as near as a right line can be, upon the periphery of an imaginary inverted cone, in such a direction that a line drawn through each axis would not point exactly to the apex of the imaginary cone above alluded to, but a little on one side of it. By this arrangement, a space like a hopper is left between the frusta, and gradually diminishes as it descends. Masses of iron at a welding heat, or thereabout, are thrown into this receptacle, and a rotary motion imparted to the frusta, which, on account of their axes being eccentric to the apex of the imaginary cone, gradually screw the heated mass downwards, compress it, and force it out through the circular space between the smaller ends of the frusta. The iron is therefore drawn out, and as it is drawn the fibres are twisted, so that they are placed in the rod much in such a way as are the yarns in a strand of rope. By giving slight eccentricity to the axis of the frusta, and great velocity of revolution, the strain of them upon their journals may be reduced to any extent required.

Puddlers' balls may be squeezed in this machine, shafts of any size may be forged, and round iron of any dimension rolled. In the experimental machine, a three-inch billet has been rolled down at one operation to a half-inch rod; and to those conversant with forges this feat will be sufficient proof of the capabilities of the apparatus, and of what may be expected from it when it shall have received those slight modifications which are the invariable result of the frequent construction and continuous operation of any new machine.

A patent has been granted for a machine for rolling the tires of railway wheels from a metal hoop, thus avoiding the bending and welding which are necessary when the tire is formed from a bar. This project is not entirely a new one, having been discussed some years since in England; but the adjuncts and modifications upon which the claims are based, are stated to be essentially necessary to the complete success of the process.

Letters patent have likewise been granted for an improvement in the apparatus for regulating the contraction of cast-iron car-wheels, by means of currents of air, and also for improvements in casting floats and rasps, by means of segmental chills, one for each tooth, the whole being fastened together in a suitable frame; and for several other improvements in the methods of casting divers articles.

A simple machine for diminishing the circumference of wheel tires, when this process shall have become necessary, either from the stretching of the same, caused by constant jar and wear, or from the shrinking of the wooden parts of the wheel, has been patented. The ordinary method is to divide the tire, cut out a piece, and then weld the ends together; but by this new process the tire is brought to a welding heat at the thinnest or most worn portion of itscircumference, and those parts of its

periphery on each side of, and contiguous to, the heated part are firmly clamped, not between the jaws, but each part in a separate jaw of a powerful vice; the jaws are caused to approach, and the heated portion is upset and contracted in length.

A machine for forming the hour-glass wire-springs, now in extensive use for furniture cushions, dispenses with the mandril now used in their construction; but further description of its operation is not possible without the aid of drawings. This latter remark also applies to an ingenious machine for cutting the teeth of bevel gearing; and likewise to one for grinding and polishing axes and other tools by automatic machinery. The characteristic of the latter being, that a rolling and traversing motion is given to the tool, which exposes every portion of it in turn to the grinding or polishing wheel.

Patents have likewise been issued for a machine for making hinges, for regulating the twist in screw augers, for forming wrought-iron railroad chairs, and for a very ingenious press for forming lead pipe, and applicable, likewise, to many other purposes. This press, unlike most others, surrounds the article to be compressed upon all sides; its top and bottom platens are stationary, and the sides, three or more in number, advance between them toward each other, and to the centre of the body to be acted upon, in such a manner that they always enclose it completely. If lead be the article to be acted upon, the sides are opened to the fullest extent, and the metal in a fluid state is poured into the box formed by them and the platens constituting its top and bottom. The ordinary die and core are made fast in the centre of either top or bottom, and when the sides are caused to advance toward each other the metal will be forced out in the shape of pipe.

Patents have been issued for a machine for cutting files, for several smiths' tuyeres, and for machines for filing and setting the teeth both of straight and circular saws, and also for a large number of machines connected with the manufacture of bolts, rivets, screw blanks, spikes and nails, all of them more or less useful, but none of them presenting striking features of novelty or interest, except when a continuously-revolving dieholder has been used in lieu of the vibrating or stationary ones hitherto employed. The use of this device renders the operation of the machine almost uninterrupted, and, in consequence, the quantity of bolts that can be manufactured in a single machine is much increased.

In the subdivision of locks and fastenings, inventions which are classed under the general head of Metallurgy, many patents have been granted, several of which are for bank locks, ingenious and complicated, of which it is impossible to give any clear idea without the aid of drawings. In the ordinary door-locks many improvements have been made, two of which will probably come into general use—one consists in a slide or protector, as it is termed, which may be applied to any lock. When the door is closed, the bolt shot, and the key left in the lock, a movement of this protector on the inside shuts the outside key-hole, clamps the key, so that it cannot be turned with a pair of nippers, and at the same time locks the latch or knob spindles. The other improvement consists in arranging the parts of an ordinary lock in such a manner, with reference to either two key-holes or one of a peculiar shape, that the same lock can be employed either as a right or left-hand lock, and the key will in neither case need to be turned upside down. By using these locks, builders may order with reference only to the number of doors, paying no attention to the side upon which they are to be hung.

Steam and Gas Engines.—A patent has been granted for placing inside of the ordinary tubular boiler flue a sheet-metal screw, with a very small spindle, around which it is formed. This screw is capable of being revolved, and its periphery is in contact with the inside of the flue. The flame and gases, instead of passing directly through the flue, must, it is obvious, be twisted round and round by these threads, and thus increase to a great extent the effective length of the flue. When the flue becomes choked to any extent by soot or ashes, if the screw be revolved it will act like a common mill conveyor, scrape the sides of the flue, and carry out the dirt at either end, at pleasure, according to the direction in which it is turned.

A patent has also been granted for certain devices necessary in arranging several sets of grate bars, one above the other, in locomotive boilers, by which it is contended that a greater amount of coal than usual can be burnt within the same fire-box rooms, thus attaining a long-sought desideratum, namely, increased grate surface, without increased size of fire-box.

A curious arrangement of boiler, by which a great amount of water is said to be evaporated, with a comparatively small quantity of coal, has been patented. In describing this boiler, it may be said to consist, first, of a hemisphere with a flat bottom, to which are attached water legs, formed by placing one tube inside of another, the space between them being filled with water, connecting at the top with the water on the bottom of the hemisphere above described. This space is closed at bottom by a ring-shaped piece of metal, and the fire-grate is formed inside of the inner tube, with a sheet-iron box below it, to which air is blown to be heated, and afterwards supplied to the fire. Both the tubes are conical, with their smaller ends down, and the outside tube increases faster in diameter than the inner one; this peculiarity causes both the fire and water spaces to be greatest in area at the top, just under the bottom of the hemispherical chamber. A number of holes are cut through these tubes near their upper ends, and the one in the outer connected to its fellow in the inner by a short flue riveted fast to both. Outside of the upright water space, and at some distance from it, another larger tube, also formed like a frustrum of a cone, is attached to the outside of the bottom of the hemisphere; its lower and smaller end extends below the hot-air box above-named, and all other parts of the boiler, and connects with the chimney or smoke-pipe. Opposite to the short flues above spoken of, as passing through the upright water space, holes are made in this latter larger tube, and through them are introduced pipes, by means of which hot air from the air-box is forced into the flame, meeting it as it comes out of the fire-box through the short flues. The gaseous products of combustion are thoroughly consumed at this point, being just at the place of greatest fire surface, and afterwards descend between the jacket and the water space; impart their remaining heat to the coldest portion of the water, and the air in the air-box, and thence escape by the chimney. This boiler would appear to be essentially non-circulating: the cool water is supplied near the bottom, and rises gradually, becoming hotter and hotter till it is converted into steam. Moreover, the most intense heat is applied to the hottest water, at the point of most extended fire surface. Almost every principle comprised in this boiler is old; but the arrangement of the devices which bring these principles into effective and economic action, is ingenious and simple in the extreme, and on this arrangement the patent is based.

Navigation and Maritime Implements.—A patent has been granted for certain novelties in the form of screw propellers, by which sheets of metal much thinner than usual may be employed in their construction; also for a species of sculling paddle, working under water near the vessel's stern, and likewise for certain modifications of the kind of paddle employed by Fitch in connection with his first steamboat upon the Delaware. Both of the latter are more distinguished by ingenuity and complication than by practicability. Certain devices for propelling boats by reaction, a stream of water being forced out on both sides, above the water line, have also been patented. Some new arrangement of a centrifugal pump and the induction channels thereto, and likewise of the points and their joints, are the basis of this patent. A model boat, constructed according to this plan, has been propelled at high speed in the harbour of New York.

Several patents have been issued for life-preservers of various kinds, among which are two for life-boats that deserve notice; in one of these the air chambers at the bow and stern are so formed and placed, that the boat cannot rest in the water in any other position than an upright one, and in the other the bottom is a water-tight box sliding up and down between the sides; if the boat be upset, and persons clamber upon its bottom, the latter slides down between the sides, leaving the cavity again uppermost, and the boat in fact in an upright position: the thwarts are so arranged as to conform themselves to this new position, and after the water is bailed out the boat is again ready for use.

A patent has been issued for a certain combination of old parts in a steamboat, in order to produce a vessel that will be able to tow a load in proportion to its power on canals, and at the same time produce no wave injurious to the banks, the wheel being at the same time arranged in such a manner as that it can receive no injury from the contact with lock-gates or bridges. The boat itself is of a well-known form, a single bow and a double stern, having a canal or open space between the sterns extending forward about half the length of the vessel. In this open space the wheel with a peculiar bucket is placed. This bucket, or these buckets or floats, instead of being, as usual, plain surfaces, are cylindrical, with their concave surface arranged in the direction of the wheel's revolution. The lines on these portions of a cylindrical surface parallel to its axis, are not parallel with, nor in the line of radii of the wheel, but are bent from their inner to their outer ends backwards in a contrary direction to the motion of the wheel, so that they strike the surface of the water when entering in a line nearer to the horizontal than usual, and leave it in nearly a vertical direction. According to the ideas of the inventor, all these peculiarities are useful when the wheel is placed as it is in his boat. As the boat passes along, the water rushing upwards from the bottom into the forward part of this canal, would pass by and over the plane bucket entering at the usual angle, but is met and grasped by the concave surface of his paddle, entering nearly horizontally, which, as it leaves the water vertically by virtue of the same inclination, produces almost no wave or swell. If any hurtful amount of the latter be

produced, the difficulty is met and the wave smoothed by another contrivance, termed a wave-queller, consisting of a curved piece of strong sheet metal, with its convex side downwards, attached at one of its ends by a hinge to a beam crossing the open passage just aft the wheel, and at the other to a screw, by means of which it can be raised or depressed. When the boat is in motion, this screw is acted upon, and the queller shoved down upon the surface of the water just as far as is necessary to smooth down the swell of the paddle. This boat has proved so successful, that its proprietors have been permitted to run it on several canals free of toll.

A patent has been granted for a very ingenious capstan, having an arrangement of cog wheels and pinions within the head and barrel, by means of which the following result is produced. When a rope is wound round the drum, and the men at the capstan-bars are heaving upon them, if the strain from any cause becomes so heavy that the men are unable to heave it further, then by merely changing the direction of their motion, they act upon the rope in the same direction, but with diminished speed and increased power, obtained by the gearing. When the heavy strain is overcome, the men again change their direction, and the rope comes in with the same speed as at first.—Two other patents have been granted for modifications of the so-termed pumping windlass, and one for improvements in the screw and nut steering apparatus; another for improvements which enable an anchor to be let go from the cathead with ease and safety; and one for improvements in deep-sea diving-bells, enclosed on all sides, and enabling the operator to work under the ordinary atmospheric pressure, instead of under that due to the depth of water beneath which he is immersed. The novelty in this case consists in the construction and method of fitting the various grasps and handles, which pass water-tight through the shell of the bell, and enable the diver to act from the inside upon substances outside of the same. Letters patent have been issued for improvements in diving-bells, intended for operating in smooth water. The bell, in place of being suspended by a chain or rope, is attached to a strong timber frame, greater in height than the distance from the bottom to the surface of the water, and this frame is arranged in such a manner that it can be depressed and raised upon guides attached to the inner sides of a twin boat or scow.

Fire-Arms and Implements of War.—More than twenty-five patents have been granted in this class, the greater number of them for improvements in repeating or breech-loading guns of various descriptions. The great demand for arms of this class during the war with Mexico, and that still existing for supplying the frontier men and those who are travelling overland across the great territories of the west, have proved a strong incentive to invention in weapons of this description. To these may be added, the accounts that have reached us, through the foreign periodicals, of the wonderful execution of the so-termed Prussian musket, with which, it is stated, correct practice may be made at a range of 800 yards, and that instances have occurred in the war between Prussia and Denmark, where the artillery-men of the latter have been picked off at their guns by the infantry of the former, when outside of the effective range of grape-shot. This gun may be described as consisting of a barrel open at both ends, but stocked in the ordinary manner. It is loaded by pushing a cartridge into the breech, or end nearest the butt of the stock; this end is then closed by a piston, or plug of metal, which is sliden along and forced into it by a handle; the plug is then turned some twenty degrees upon its axis, the handle entering into a slot in a piece of metal attached to the stock, thus fastening the piston so that it cannot be forced backwards when the charge is exploded.

The explosion is effected by means of a needle, moving in a hole in the axis of the piston, which is retracted into the piston, and confined there by the combined action of pulling back the same to open the breech, and shoving it forward to close the opening after the cartridge is in position. A pull upon the usual trigger liberates the needle from its catch, when it is forced forwards by a spiral spring, and its point passes out of the piston into the cartridge, and through the powder contained in the same, until it comes in contact with a small pellet of percussion powder, located in the cartridge, between the powder and the ball. This pellet is fired by the concussion, and inflames the powder from the front towards the rear of the barrel. This gun has been described as a necessary basis for the correct understanding of several others, modifications of, and improvements upon it, patented in this country during the past year; and its advantages would appear to be threefold—first, great rapidity of firing; second, accuracy; and third, extent of range. The former is dependent solely upon the loading at the breech. The second advantage is secured by the breech-loading, which permits of a ball being used of greater diameter than any portion of the bore, except for a small distance, near the breech, the ball being slugged by the explosion of the powder, and, if necessary, forced to fit tightly into rifled grooves; it has, therefore, no windage. The third result depends upon the last-mentioned cause, and the fact that the powder is fired from front to rear; the combined consequence being, that the whole charge is exploded, and that none of the gases can escape between the ball and the barrel. A very simple improvement on this gun has been patented, the application of which renders it impossible to fire the gun even by a pull of the trigger, unless the breech is in proper position and locked. Three patents have been granted for guns which have, in addition to the features of the Prussian gun, a reservoir of cartridges under the barrel, and machinery which elevates one charge at a time from the same, and places it in front of the sliding piston, which latter, when moved forwards, shoves the cartridges into place for firing.

A patent has been issued for what appears to be a great improvement upon the ordinary many-barrelled revolver. It consists in attaching the barrels firmly to the stock in such a manner as to be incapable of revolution, while the lock is so contrived and arranged that it is cocked and discharged by pulls on the trigger, the hammer travelling from barrel to barrel in succession, and firing one after the other. It is obvious that this arrangement of revolving hammer and stationary barrels, permits of more correct practice than the usual one. A patent has been granted for an improvement on this pistol, consisting in an important simplification of the lock. Many new modifications of that species of lock which is cocked by a pull of the trigger have been patented, one of which is so constructed that the gun is fired when the pull on the trigger is slacked. Patents have been issued for loading muzzles of rifles; for various kinds of breech-loading fire-arms; for improvements in concealed locks; for modifications of the faucet-breeched gun, and a magazine adapted thereto; for a breech loading, and for a sectional cannon. The construction of the latter may be described as follows:—Drill any convenient number of holes through the metal of a cannon, midway between the outside of the bore and the outside of the gun, and parallel to its axis, then saw the gun through at right angles to these holes in many places. A number of disks will be left, each with a corresponding central hole for the bore; with numerous smaller apertures, corresponding in each section, the result of the drilled holes first spoken of, and with an outer periphery, shaped in accordance with that part of the gun from which the disk has been cut. Now, if disks of wrought-iron, formed precisely like these, are manufactured, assembled properly together, and long bolts passed through the small holes, a sectional wrought-iron cannon will be formed, which admits of being taken apart at will. Patents have been granted for a very ingenious arrangement of punches, dies, transferers, and feeding apparatus, for punching out and knocking up percussion caps at one operation; for a machine for spherifying leaden balls; for an improved method of boring muskets; and for improvements in that kind of powder magazine whose walls are double, with a provision for circulating water in the interstices in case of fire occurring on board the vessel. These improvements consist in a self-acting apparatus for letting on the water, and in a peculiar kind of entrance, preventing the passage of sparks, &c., unless carried in by the person entering. A patent has also been granted for an improved method of making small shot, based upon forcing a strong current of air up through the tower, meeting, and, to a certain extent, supporting, the descending lead. Shot of certain sizes can by this process be made in a sheet-iron tube in an ordinary house, instead of in the high tower usually employed.

CHEMICAL AFFINITY AND THE ATOMIC THEORY.

The Atomic Theory assumes that every mass of matter is composed of impenetrable particles, termed atoms or molecules, so small that they are incapable of division; and that these are not placed in actual contact, but are divided from each other by very minute spaces. Bodies, therefore, which to our senses appear perfectly continuous—a piece of glass, for instance—must not be considered as completely filling all the space they appear to do, but as being an aggregate of material particles and empty spaces, the particles being held together, in a given form, by forces called atomic or molecular forces, until compelled to change that form by some application of diverse force. It is further assumed that the atoms of all bodies have the same density, and, consequently, that the differences of their weights are owing to differences of volume. When a body suffers compression or expansion under the influence of force, the atoms themselves remain unaffected: it is only the spaces between them that undergo diminution or enlargement; therefore, a decrease or increase in the size of a body is effected, in the one case, by placing the atoms nearer one another; in the other, by placing them at greater distances.

In regard to the ponderable fluids, each atom is supposed to be enveloped by a sphere of caloric, the principle of elasticity, which keeps the

atoms at certain distances from one another, in opposition to the force of attraction which would place them in actual contact. In liquids, the heat-sphere occupies only a small space—enough, however, to give increased mobility to the particle; but in gases it is so great that the volume of the atoms is very small indeed, compared with that of the calorific envelopes.

A compound atom is formed when a chemical combination takes place under the influence of affinity; and the mode in which such a result is brought about, is supposed to be by the symmetrical arrangement of one or more atoms of one substance, by the side of one or more atoms of another substance.

Chemical affinity is a species of attraction which combines bodies of different natures in such a manner, that a new body is produced. After combination the component particles are no longer to be found, and the new body presents a mass of perfectly uniform constitution.

Every simple body is capable of forming a chemical compound with some, if not all, other simple bodies. In those cases where two simple bodies have hitherto refused to combine (carbon and mercury, for instance, or nitrogen and iron), it may be that they have never yet been brought together under the conditions necessary to the operation of affinity. Compounds of the *first order* are those which result from the union of two simple bodies; compounds of the *second order* are formed by the combination of a simple body and a compound of the first order, or of two compounds of that order. The highest orders are formed in a similar manner. It sometimes occurs that simple bodies refuse to combine with each other directly, and yet the compounds they form with other simple bodies will readily combine. Again, a case of this kind is sometimes met with: one simple body will combine with another of two other simple bodies, whilst a strong affinity exists between it and the compound of the other two. Mercury, for instance, will not combine with either carbon or nitrogen; but for their compound, cyanogen, it exhibits a powerful affinity.

Affinity only takes place at insensible distances. It is, in most cases, necessary to the combination of two bodies, that one of them, at least, should be in the state of a liquid or a gas. An elevation of the temperature materially assists combination; light and electricity also favour it. There are several bodies (most of them possessing a high degree of elasticity or cohesiveness) which can only be made to combine by the co-operation of a chemical combination between other bodies. For example, nitrogen and hydrogen will not combine to form ammonia under the influence of either heat or electricity; but when tin filings are placed in contact with water and binoxide of nitrogen, the metal will attract the oxygen of both these bodies, and the hydrogen, disengaged from the water, will combine at the moment it is set free, with the liberated nitrogen of the nitric oxide, thus forming ammonia.

A change in temperature takes place on the chemical combination of bodies; sometimes it is a fall, but usually it is an elevation, of temperature that occurs.

The chemical combinations of bodies usually take place in fixed and definite proportions; and this is the more apparent, as the affinity between the bodies is stronger. Such proportions are unaffected by temperature or outward pressure; and the compound, in whatever way formed, is always made up of the same proportions. In some cases two bodies combine in one proportion only, in which case each is saturated with the other. For example, chlorine and hydrogen combine only in the proportion by weight of 35.4 and 1; zinc and sulphur only of 32.2 and 16. When two bodies, A and B, combine in two definite proportions and no more, then A is saturated with B at one of these, and B with A at the other: *e. g.* 35.4 chlorine combines with 101.4 mercury, to form corrosive sublimate; and here the gas is saturated with the metal: 35.4 chlorine also combines with 202.8 mercury, to form calomel, in which case the metal is saturated with the gas. But two bodies frequently combine in more than two proportions: *e. g.* 14 nitrogen + 8 oxygen = nitrous oxide; 14 nitrogen + 16 oxygen = nitric oxide; 14 nitrogen + 24 oxygen = nitrous acid; 14 nitrogen + 32 oxygen = hyponitric acid; 14 nitrogen + 40 oxygen = nitric acid.

The combinations that take place amongst atoms when brought under the influence of affinity, are in simple numerical proportions; as, for example, in the case of nitrogen and oxygen, where 1 atom of nitrogen unites with 1, 2, 3, 4, or 5 atoms of oxygen. It is seen that the different compounds thus formed depend upon the quantity of oxygen which they respectively contain, and that the larger quantities are multiples of the quantity contained in the first combination; hence this law is called the law of *multiple proportions*. When it is known in what proportion A combines with B on the one hand, and with C on the other, we are furnished with data for calculating the proportion in which B and C will combine. Thus, if it is found by experiment that 1 part of A combines with 3 parts of B and with 8 parts of C, then B and C must combine either in the proportion of 3 B to 8 C, or in the proportion of some multiple of one or both of these numbers. This is the law of *equivalent quantities;* so termed, because, when the relative proportions are known in which bodies combine with any one, the proportions are also known in which they combine amongst themselves, and hence the quantities represented by these numbers are equivalent to, and may be substituted for, each other. Both these laws apply to compounds as well as to simple substances.

When we speak of the weights of atoms, it must be understood that we refer to their *relative* weights only; for of their absolute weight we can know nothing. The relative weight is learned by ascertaining the proportions by weight according to which the bodies combine; and if we represent the atomic weight of any one substance by a particular number taken at pleasure, we may determine the atomic weight of the other bodies with which it combines. The atomic weight of hydrogen is by some chemists (following Dalton) taken as unity; but others agree with Berzelius in taking oxygen as the standard, and = 100. In favour of the first scheme, it is to be remarked that the atomic weights of many other simple bodies are exact, or nearly exact, multiples of that of hydrogen.

In proportion to the number of atoms included in a given space, and to the weight of such atoms, will be the specific gravity of the body—the specific gravity being the product of the atomic number and the atomic weight. In gaseous bodies, the atomic weight bears a much simpler relation to their specific gravity, than is the case with respect to solids and liquids in which various disturbing causes interfere. Elementary bodies in the gaseous state contain either $1.x$, or $2.x$, or $6.x$ atoms in a given volume, but liquid and solid bodies contain very different numbers of atoms in equal volumes. Potassium has the smallest (245), and carbon the greatest (6481), atomic number of all liquid and solid bodies. In the table at the end of this paper will be found a list of the elementary bodies, with their atomic weights and specific gravities. By dividing the specific by the atomic weight, we shall obtain the atomic numbers when water = 1; and since air is 770 times lighter than water, if we multiply the atomic number thus obtained by 770, we shall obtain the atomic number when air = 1. This last atomic number being divided by the atomic number of hydrogen (0.0693), we shall have the number of atoms of the other elementary bodies contained in a space which would include 1 atom of hydrogen.

The sum of the atomic weights of the simple substances forming a compound, gives the atomic weight of the compound. From what has been previously stated, the quantity of a substance in a compound will depend upon the number of atoms of the substances, and the weight of those atoms. Consequently, the quantity, M, of the constituents in a given quantity of the compound, is ascertained by multiplying the number of atoms, Z, of each constituent by the above weight, G. Hence the three following formula:—

$$(1.)\ M = Z \cdot G \qquad (2.)\ G = \frac{M}{Z} \qquad (3.)\ Z = \frac{M}{G}$$

These formulæ, with the assistance of the rule of three, are of great assistance to the chemist in his laboratory. If he wishes to determine the quantities of the several constituents in a given quantity of any compound, or to ascertain how much of any substance, simple or compound, is required to convert a given quantity of another substance into a given compound, or to decompose a given quantity of any compound, then the first formula comes into use. The atomic weight of a substance may be found by means of the second formula, when we are acquainted with the relative quantity of it in a given compound—also the number of its atoms probably entering into the compound. When we know the relative quantities and atomic weights of the atoms of the different constituents of a compound, we may find, by means of the third formula, in what numbers they are united.

With the view of saving time in making the requisite calculations, which, though simple enough, are frequently very numerous, Dr. Wollaston invented his scale of chemical equivalents, framed on the plan of the common sliding rule, which has been found of considerable use where approximate accuracy only is required.

Mitscherlich's theory of Isomorphism has rendered assistance in determining some atomic weights. It consists in this, that isomorphous bodies —that is to say, those which assume the same crystalline form—may generally be considered as composed of the same number of atoms, united in the same manner.

Decomposition is the resolution of a chemical compound into its elements, and this is effected in the majority of instances by bringing into play, by means of the introduction of another body, stronger forces of affinity than those which bind the elements together. In other words, a destruction of the compound takes place in order that a new compound may be formed, the affinities between the constituents of the latter being greater than those which subsist between the constituents of the former. The following are the principal cases which fall under this head:—1,

When a compound, A B, is brought into contact with the body C, A B is decomposed, the new compound, A C, is formed, and the body is liberated. For instance, when oxide of zinc is heated to redness in contact with charcoal, it is resolved into carbonic oxide and metallic zinc. 2. The action of the body, C, on the compound, A B, produces two new compounds, A C and B C. Thus, sulphuret of carbon burned in oxygen gas produces sulphurous acid (sulphur + oxygen) and carbonic acid (carbon + oxygen). 3. The action of the two separate bodies, C and D, on the compound, A B, produces the compounds, A C and B D. 4. Two compounds, A B and C D, are brought into contact, and the new compounds, A C and B D, are formed. This is a case of what is termed double elective affinity, and it is most frequently seen when solutions of two salts, containing different acids and different bases, are mixed together; the acid of the first combines with the base of the second, and the acid of the second with the base of the first. In like manner two compounds, A B C and D E F, are resolved into the three compounds, A D, B E, and C F, as in the case of hydrosulphate of ammonia and nitrate of lead, which, upon commixture, produces sulphuret of lead, water, and nitrate of ammonia. 5. The contact of A B and C D yields only one new compound, A C, and the bodies B and D having no affinity for each other, are liberated in the free state. 6. When a body, E, is brought into contact with the independent compounds, A B and C D, it combines with A, brings B into combination with D, and sets C at liberty.

As to the laws by which the strength of affinity is regulated, it may be laid down, that if A combines with different quantities of B, it holds the first quantity of B with greater force than the second, the second with greater force than the third, and so forth. The strongest affinities are exhibited by the simple substances for each other; and then come the compounds of the first order, compounds of the second order, &c. The tendency of the elements to form further combinations diminishes in proportion as their affinities are satisfied by combination, and in the end it ceases altogether. The affinity of bodies is, generally speaking, more strong in proportion to the differences of their physical properties.

Catalysis is the name given to the singular action of a solid or liquid body, by its mere presence upon slumbering affinities of a compound. The body itself does not undergo any change, or, if a change does ensue, it does not enter into combination with any of the elements of the compound. Catalytic force is regarded by Berzelius as a peculiar manifestation of electro-chemical action.

The word *Dimorphism* expresses the capacity of the same compound to assume forms belonging to different systems of crystallisation; calcareous spar and aragonite, for instance, both of which are carbonates of lime, distinguishable chiefly by the incompatible forms of their crystals. This difference of form, which seems to depend principally upon temperature, is associated with difference of specific gravity, hardness, colour, &c. *Polymorphism* is used to denote all those changes which are confined to the physical properties of a body, and do not extend to its chemical nature. We say *nature*, and not chemical composition; for in fact there are some compounds which have the same chemical constitution, but very different natures. Such are tartaric and para-tartaric acids—malic and citric acids—cyanuric and fulminic acids. The acids of each of these three couples have the same composition, and yet they form dissimilar combinations with the same bodies. In other words, although these acids exhibit different physical and chemical relations, their compound atoms contain the same elements combined according to the same number of simple atoms. Compounds possessing this property are termed *isomeric*. It is thought that an explanation is to be sought for in a different grouping of the constituent atoms.

When compounds made up of the same elements, in similar proportions but in different quantities, possess different physical and chemical properties, they are said to be *polymeric*. We know of several compound gases, liquids, and solids, which contain carbon and hydrogen in exactly the same proportion, viz.—1 atom of C to 1 of H. But when the atoms are united in the different quantities, $C^4\,H^4$, and $C^8\,H^8$, $C^{16}\,H^{16}$, and $C^{64}\,H^{64}$, we have the matters known as methylene, olefiant gas, quadricarburet of hydrogen, and cetine.

We have given an example, in the last sentence, of the symbolic language used by chemists to represent the atomic constitution of bodies. All the elementary bodies are designated by their initial letters, as will be seen in the table with which this paper concludes—an exponent placed on the right of the letter indicates the number of atoms of the several constituents which exist in a particular compound. Thus, Fe represents an atom of iron; Fe O an atom of the protoxyde of iron; $Fe^2\,O^3$ an atom of the peroxyde. Proximate and ultimate elements are indicated by means of points, commas, + signs, and brackets; and it is a common practice to indicate oxygen, which enters into so many compounds, by points placed over the symbol of the body with which it is combined, the number of points expressing the number of atoms. Thus $C\,O^2 = \ddot{C}$ (carbonic acid). Again, $K\,O + C\,O^2 + H\,O = K\,O, C\,O^2, H\,O = \dot{K}\,\ddot{C}^2\,\dot{H}$ (bicarbonate of potash).

ATOMIC WEIGHTS AND SPECIFIC GRAVITIES OF SIMPLE BODIES.

Names of Bodies.	Symbols.	Atomic Weights.		Specific Gravity. Gases: Air = 1. Solids & Liquids, Water = 1
		O = 100	H = 1	
Aluminum,	Al.	171.167	27·432	....
Antimony,	An. or Sb.	806·452	129·243	6·7010
Arsenic,	Ar. or As.	470·042	75·329	5·959
Barium,	Ba.	856·880	137·325	....
Bismuth,	Bi.	886·918	142·139	9·822
Boron,	Bo. or B.	136·204	21,828	....
Bromine,	B. or Br.	489·153	78·392	2·98
Cadmium,	Cad. or Cd.	696·767	111·665	8·3655
Calcium (Berzelius),	Cal. or Ca.	251·942	40·304	....
Do. (Dumas, Erdmann, and Marchand),	....	250·000	40.000	....
Carbon (Berzelius),	Car. or C.	76·438	12·250	3 5
Do. (Liebig),	....	75·850	12·140	....
Do. (Dumas),	....	37·500	6·000	....
Do. (Marchand and Erdmann),	....	75·000	12·000	....
Cerium (Berzelius),	Ce.	574·796	92·102	....
Do. (Beringer),	....	577·000	92·928	....
Chlorine,	C. or Cl.	221·326	35·470	2·4543
Chromium,	Chr. or Cr.	351 815	36·382	5·9
Cobalt,	Co.	368·991	59·135	8·5384
Columbium, or Tantalium,	Col. or Ta.	1153·715	184 896	....
Copper,	Cu.	395·695	63·415	8·721
Fluorine,	F.	116.90	18·734	....
Glucinum (Berzelius)	G.	331·261	53·088	....
Berillium (Awdejew),	Be.	58·084	9·308	....
Gold,	Au.	1243·013	199·207	19·2
Hydrogen (Berzelius)	H.	6·239	1·000	0·0693
Do. (Dumas and Erdmann)	....	6·250	1·000	....
Iodine,	I.	790·460	126·567	4·948
Iridium,	Ir.	1233·499	197·682	18·63
Iron,	Fe.	339·205	54·363	7·8439
Lauthanium,	Lan. or La.	451·879		....
Lead,	Pl. or Pb.	1294·498	207·458	11·3889
Lithium,	Li. or L.	80·375	12·881	....
Magnesium,	Mg. or Mag.	158 353	25·378	....
Manganese,	Mn. or Man.	345·887	55·432	8·0
Mercury,	Hg.	1265·822	202·863	13·559
Molybdenum,	Mol. or Mo.	598·520	95·920	8·6
Nickel	Nic. or Ni.	369·675	59·245	8·637
Nitrogen, or Azote,	N.	88·518	14·186	0·0506
Osmium,	Os.	1244·487	199·444	10·0
Oxygen (Berzelius),	O.	100·000	16·026	1·1093
Do. (Dumas and others),	....	100·000	16·000	....
Palladium,	Pal. or Pd.	665·899	106·708	11·5
Phosphorus,	P.	196·143	31·436	1·75
Platinum,	Pla. or Pt.	1233·499	197·682	21·5
Potassium, or Kalium,	Po. or K.	489·916	78·515	0·865
Rhodium...,	Rh. or R.	651·387	104·392	11·2
Selenium,	Se.	494·582	79·263	4·31
Silicium,	Si.	277·312	44·442	....
Silver,	Ag.	1351·607	216·611	10·248
Sodium, or Natrium,	So. or Na.	290·897	46·620	0·9722
Strontium,	Str. or Sr.	547·285	87·709	....
Sulphur,	S.	201·165	32·239	2·0
Tellurium,	Tell. or Te.	801·760	128·5	6.258
Thorium,	Th.	744·910	119·292	....
Tin,	Sta. or Sn.	735·296	117·840	7·29
Titanium,	Ti.	303·662	48·664	5·28
Tungsten, or Wolframium,	Tu. or W.	1183·0	189.59	17·4
Vanadium,	Va. or V.	855·846	137·157	....
Uranium,	Urum. or U.	750·0	120·0	9·0
Yttrium,	Yt. or Y.	402·514	64·508	....
Zinc,	Zn.	403·226	64·621	6·9154
Zirconium,	Zir. or Zr.	420.201	67·340	....

INVENTORS AND WHAT THEY HAVE DONE.

By THOMAS EWBANK, ESQ., *Commissioner of Patents, U. S.*

A world without inventors would consist only of forest and swamp. Before they appeared, it was—and where they are not, it is—an Australian jungle, through which men, affiliated with beasts, roam in quest of miserable subsistence and shelter. The difference between the civilized and troglodytes is, one class contrives, the other does not. Nothing is clearer than that mechanical inventions are ordained to animate, clothe, and adorn a naked and torpescent world—to infuse into the species the elements of increasing vigour and felicity. Even as arts multiply and flourish, the chief labour of working out the great problems of existence continues to devolve upon inventors. Without them, the prospects and hopes of the present had neither been seen nor felt. It is they who, by discovering new physical truths, are establishing the grandest of moral ones—*Perpetual Progress*—illimitable advancement in social, civil, and intellectual enjoyments.

The fact has scarcely, if ever, been glanced at, that nearly every marked advance of civilization began with and is due to inventors. Without disturbing old records, it is enough to turn a leaf of modern

history. The substitution of fire-arms for primitive weapons, has wrought an entire change on the face of society. Another and ever memorable epoch was introduced by the revivers of printing, and inventors of type-founding; another by steam as a motor; to say nothing of the revolutions brought about more recently by spinning-jennies, power-looms, ocean steaming, gas-lights, photography, railroads, telegraphs, &c., which so honourably distinguish our times from all that preceded them.

But for the artificer's skill, the sublimest of the sciences had not been attempted, nor the sublimest triumphs of human reason and research achieved. By means of two inventions, the extremes of creation are brought within the range of human observation, and the grandest of conceivable miracles demonstrated. With the microscope, the human eye discovers animated worlds in drops of liquid and grains of fecula, and may yet detect ultimate atoms in the most attenuate of the gases. By the telescope, the same eye penetrates and wanders at leisure through a space far beyond what was once thought the limits of an arch-spirit's flight. Leaving the satellites of remote planets behind, it resolves the infinitely more remote nebulæ, and, sweeping round the awful horizon, takes in what would seem half the universe.

At a more favourable time than Fitch lived in, Fulton rose, and steamers began to creep up rivers, next dashed over lakes and inland seas, and now are rushing in fleets over every ocean. Whitney appeared, and forests were swept away to make room for cotton fields—thus turning the soil from harbouring beasts of prey, to raising clothing for half mankind. Daguerre, and the sun turns portrait-painter—exemplifying a classic myth. Stranger still, Morse and his compeers have bridled the most subtle, fitful, and terrific of agents, taught it to wait, silent and prompt, as a page in a monarch's ante-chamber, and when charged with a message, to assume the character of a courier whose speed rivals thought and approaches volition. From the beginning, means more or less rude and refined have been employed for the conveyance of material things, but not until now has the transportation of thought—of thought divested of aught visible or ponderable—been attained. Indian runners hasten with information through floods and forests, over hill and dale; but to carry it, they convey themselves as packages containing it, or as tablets on which it is impressed. So also with the contents of our mails—minds commune with distant minds through the gross medium of printed and written paper; whereas, by means of artificially evolved lightning, a postal system is established akin to the spiritual; for by it, thoughts are made to dart through space unclogged by symbols and envelopes, and consequently unretarded by carriers and postmen.

The wildest freaks of fancy have been strangely verified in the telegraph, as *outré* bottle-imps and more attractive fairies; giving colour to the proposition, that in nature's arcana are germs of every popular superstition, and that no prevalent delusion is without its corresponding truth. Be this as it may, the chiefs of modern Prosperos, by means of a few strips of metal, release from jars of acid spirits so agile and obedient, that, on the slightest tap of its master's finger, each one flies with messages over a hundred leagues of latitude, delivers them, returns, and is in waiting for others before the signals can be repeated, or the pulse beat twice! An ancient elf boasted of putting a girdle round the earth in forty minutes—these modern sprites can really do it within half a one. If art and science allied have done such things, what is it they cannot do?

If machinery don't *think*, it does that which nothing but severe and prolonged thinking can do, and it does it incomparably better. In the composition of astronomical and nautical tables, accuracy is everything. Many a ship has been wrecked through wrong figures in "Guides" to navigation; but absolute accuracy, continued through abstruse calculations that occupy months, and sometimes years, is too much to expect even from the most sagacious, studious, and careful. But suppose it attained; the next difficulty is to transfer the results, untainted with error, to printed pages—a source of mistakes which few besides authors and printers can appreciate. If other persons were told of the impossibility of copying from manuscript millions of figures without misplacing, leaving out, or inverting more or less, they would hardly yield their assent. It is enough to say that perfection in elaborate and difficult calculations is unattainable with certainty by human figuring; nor is it to be expected in the professional labours of the most expert compositors.

Now, automata have been made to work out arithmetical problems with positive certainty and admirable expedition; relieving mathematicians and others of an incalculable amount of mental drudgery—drudgery that has worn out the strongest constitutions. Moreover, they carry the use of numbers further than the clearest intellects dare follow—to an extent that language lacks terms to express. In human computations, minute errors creep in and corrupt the whole, often requiring months of the closest ratiocination to find out; but calculating machines detect their own mistakes at once, correct them, and then shutting out the interference of human fingers as well as heads, and with them the chance of marring the work, they print their tables as well as compose them—thus producing works to which entire confidence can safely be given.

The power inventors wield is not less manifest in the changes they have wrought in the habits, customs, and occupations of females, than it is obvious in the pursuits of the other sex, in the outdoor world. They have not only broken up the time-honoured arrangements of the kitchen, wash-house, and dairy, but have invaded the parlour and even boudoir. A century ago the rock and spindle were common; in Europe are women who still twist thread with their fingers. Fifty years since, the wheel had a place in every dwelling, and carding no less than spinning was a domestic duty. With thrifty housewifes, the shuttle, too, was not a stranger. Within twenty years knitting was indispensable; not a few of our farmers still wear homemade hose. Then straw-plaiting, tambour-working, lace-making, plain and fancy embroidery, with other delicate operations of the needle, were and are still taught as necessary accomplishments. Such they will hardly be held much longer, since these and various other performances are now done by automatic fingers with a precision, regularity, despatch, delicacy of touch and finish, that no human organs can rival.

Most, if not all, of the fine arts have been subdued by mechanism. The lathe is still to be met with in its primitive forms, in the potter's wheel, the spring-pole instrument, and also as used in the modern Egyptian's atelier—(seated on the ground, this artist employs one hand to revolve the object to be formed, holds the cutting tool in the other, and presses it on the rest with his toes.) The lathe, so long confined to shape articles whose sections were circles, now produces oval, elliptical, epicycloidal, and eccentric work; copies medallions, and even busts in equal, enlarged, or reduced proportions—performing the work of the engraver, die-sinker, and statuary or sculptor.

The richest figured tapestry and damask in relief, are now produced by magic mechanism. Looms rival the palette and burin; besides gorgeously-coloured carpets, they weave landscapes equal to oil paintings, and portraits after the finest line engravings. Then, from the increase in number of sewing machines, the time would seem not distant, when the needle itself, and thimble, will be exhibited in museums with distaffs, spinning-wheels, knitting-wires, tambour-frames, hand-looms, lace-making bobbins and pillows, and other antiquarian curiosities, as evidences of imperfect civilization. In chromo-lithography, automaton artists rival the finest touches of old masters, and shortly will multiply, by millions, their most esteemed productions.

Though not suspected, the power of inventors over human affairs is already supreme; machinery even now governs the world, though the world does not acknowledge it.

ERRORS ENTERTAINED RESPECTING INVENTORS.

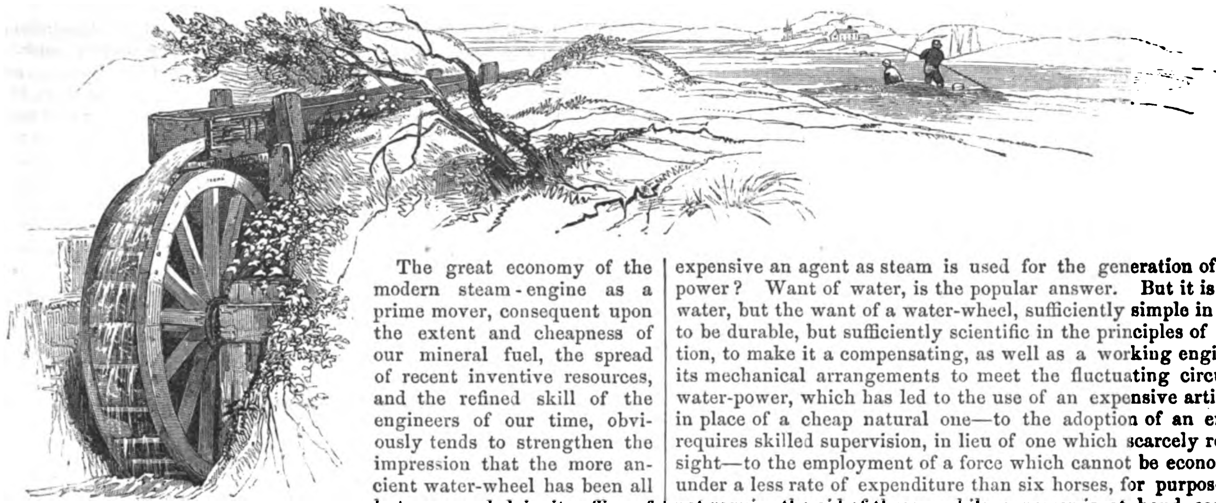
It is a prevalent opinion, that both ordinary and extraordinary inventions cost their authors little labour and thought to develop; nothing is more erroneous. It is an essential element of man's being, and of the constitution of things under which he exists, that all truths, mechanical or philosophical, can only be realized by strenuous and continued effort. Our perceptive faculties are too obtuse, and happily for us it is so, to apprehend them at a glance. In that case, they would be held too cheap to be looked for, and deemed worthless when seen. If inventions required no exertion to discover, where would be their value? If virtue cost nothing, it would cease to be virtue. No fact is clearer than that man's destinies are in his own hands, and that he alone can exalt and debase them. To rouse him to be faithful to himself, is nature's ceaseless care. With powers dormant in him, and equal to every exigence, she leaves him to exert them or not. She does nought for him that he can do for himself, and has taken care that he shall know nothing, have nothing, that he does not strive for.

It is common to hear ingenious men disparaged by ascribing their best things to lucky or random suggestions; whereas, though appearing fortuitous, they may always be traced to previous reasonings or reflections—sprouting seeds, whose transient plantings had been little noticed and forgotten. They had never sprung up had they not fallen on soils prepared by previous culture to receive them. Sparks set not sand on fire, nor do fruitful ideas germinate in barren minds. Flashes of thought, like those of the electric fluid, may dart suddenly and unexpectedly, but they are not less the regular effects of inducing causes. Inspiration descends not in its highest or its lowest forms, but on those who seek to be inspired.

It is not given to man to perfect aught without toil, and seldom without long-continued toil. The smith forges not a ploughshare with a blow, nor is any new device, however simple, matured save by repercussions of thought. *Nul bien sans peine* is a universal truth.

GWYNNE'S DOUBLE-ACTING BALANCED PRESSURE WATER-WHEEL.

(*Illustrated by Plate* 72.)



The great economy of the modern steam-engine as a prime mover, consequent upon the extent and cheapness of our mineral fuel, the spread of recent inventive resources, and the refined skill of the engineers of our time, obviously tends to strengthen the impression that the more ancient water-wheel has been all but superseded in its office of lightening human labours. But the returns of the Registrar of Factories show us, by plain facts, that such a notion is greatly in error. We have, in the United Kingdom, no fewer than 4,300 textile workshops of all kinds, the machinery in which is actuated by 134,217 horses' power. Of this aggregate, it may be worth while to know that water accomplishes work to the extent of above 26,000 horse power, or very nearly one-fourth of the steam force employed. Even in Lancashire, where coal is so cheap, one-ninth of the total mill-power is derived from water; and here it has been calculated, that but 6 per cent. of the entire power available for industrial occupation is turned to account.

The case in the agricultural counties is much worse, as most farmers, millers, fullers, and paper-makers, who usually seek the rural districts, can testify.

Water-power, when administered by unskilful hands, is generally either wasted or misapplied through the medium of clumsy machines, which are one-half their time choked with water, and at all times literally forced to work "against tide," delivering but little transmissive power, and that, too, in an uncertain and intermittent manner.

We are entitled, therefore, to repeat, that the economic employment of water-power is an object of national importance. But the value of this assertion becomes more apparent, when it is considered, that if all the rain which falls on the surface of England in a year were collected, it would cover the land to the depth of 30 inches in the midland and level counties, to 50 inches in the more maritime districts, and to as much as 300 inches in Cumberland and Westmoreland.* Of this enormous quantity, fully one-third, as it passes to the sea, may be made available to industry, with a force proportioned to the height through which it falls. It is a power, therefore, which almost every one has within his reach: in the open country, by the use of the natural streams, or the collection of surface waters; and in those towns, now increasing in number, supplied on the "constant system," by the use of waters commercially furnished, as at Preston, Ashton-under-Lyne, Wolverhampton, Nottingham, Stirling, Paisley, Glasgow, and, to some extent, in Liverpool.†

In the face of these advantages, the question is often asked, why so expensive an agent as steam is used for the generation of mechanical power? Want of water, is the popular answer. But it is not want of water, but the want of a water-wheel, sufficiently simple in its structure to be durable, but sufficiently scientific in the principles of its construction, to make it a compensating, as well as a working engine; fitted in its mechanical arrangements to meet the fluctuating circumstances of water-power, which has led to the use of an expensive artificial power, in place of a cheap natural one—to the adoption of an engine which requires skilled supervision, in lieu of one which scarcely requires oversight—to the employment of a force which cannot be economically used under a less rate of expenditure than six horses, for purposes which do not require the aid of three; while a power is at hand, capable of profitable adaptation to the smallest as well as the largest requirements of industrial labour.

To remedy these evils, and to furnish the public with an engine of universal application, of constant action, and of great power, has been the object of the patentee of the double-acting balanced pressure-wheel. But before calling specific attention to his invention, the following notice of the old-fashioned forms of wheels may not be out of place.

Water engines may be reduced to four classes. In the first, the water acts by its weight; of this kind is the "overshot water-wheel." In the second, the action is by impulse, as in the "undershot wheel." In the third, it is by pressure, as in the "water-pressure machine." In the fourth, it is by reactive pressure, as in Barker's mill; and similarly, reactive impulse gives origin to the horizontal or "tourbine" wheel.

The Overshot Water-Wheel is the most ancient engine of water-power. It belongs to an early age of civilization; and, as might be expected, it possesses no power of adaptation to meet variable circumstances. Its construction, however, requires considerable mechanical skill, that its powers may be brought fully into play;—the form of the buckets; the quantity of water let into each bucket; the point of the circumference at which the water is to be let on; the exact centering of it, so that its motion be absolutely uniform;—all these are points which require an amount of scientific skill but rarely possessed by provincial manufacturers; and it follows, that on faults being made in a prime mover, the injurious results are very serious. Moreover, it must be recollected that the water should act only by its weight; the principle upon which its maximum action depends being, that the water should enter the wheel without impulse, and should leave it without velocity. The fulfilment of such conditions greatly narrows its use, and makes it undesirable in all cases of economic procedure. Here, however, an honourable exception must be made. Mr. Fairbairn, to whom the public is so largely indebted for many valuable discoveries, both in the principles and practice of engineering science, has invented a modification of the Overshot Wheel, entitled by him the Ventilating Water-Wheel, in which all that ingenuity could suggest has been brought to bear upon its improved construction.

The Undershot Wheel is chiefly employed in level districts, where,

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* *Vide* Dr. Miller on the Rain Fall of Cumberland and Westmoreland. Philosophical Transactions, 1849.

† Report of the General Board of Health on Water Supply, 1851, in which the Commissioners say—

"There are various convenient and economical modes of applying water to gain intermittent power. A warehouseman, for instance, might desire the power of a small steam-engine to work a crane to unload or load two or three carts or waggons; but it would not be worth his while to keep a steam-engine in readiness for such a service during the whole day. Steam-engines, moreover, require skilled superintendence. With a constant supply of water, a tap merely is turned, and the hydraulic pressure becomes a means of motive power appliable at once, and capable of being immediately discontinued." Mr. P. Holland, who gave evidence before them, thus illustrates the convenient application to industrial purposes of the hydraulic power derivable from the constant supply:—"At present," he says, "many tradesmen employ very small steam-engines for purposes that may be almost as cheaply accomplished by hand; for instance, coffee grinding. There are many purposes for which steam might be substituted for manual power with advantage, were it not for the cost of the skilled labour required to attend to it, and the expense and trouble of keeping up the steam when the power is not wanted. If some hydraulic engine, such as the tourbine, were employed and worked by water from the pipes—which could be set at work and stopped in an instant, which consumes no power except when at work, which requires no skilful mechanic to work it, and is quite free from risk from fire or explosion—there is no doubt that numerous applications of such power would be introduced, which are as yet scarcely thought of. It would be easy to work cranes and hoists for raising and lowering goods and persons in warehouses, where the occasions for their use are not sufficiently numerous to make a steam-engine economical. I have known a warehouseman pay £20 a year rent for the occasional power derived from a neighbour's steam-engine for working his packing presses. Such an instrument would work presses in the smaller printing offices, where it is not worth while having a steam-engine. Turners might work their lathes, and smiths their bellows, by water-power; chaff might be cut, and oats and beans crushed, by the same means. In fact, it is impossible to mention all the various uses to which it might be applied, if water were supplied constantly and at high pressure."

GWYNNE'S WATER-WHEEL.

Fig. 1.

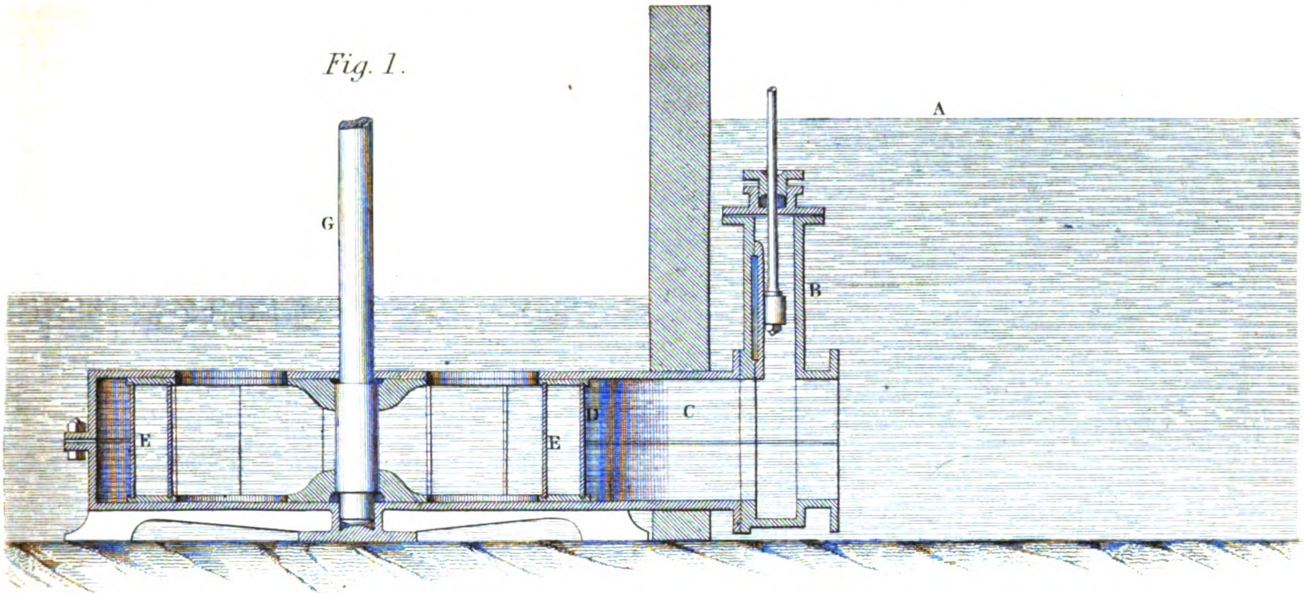


Fig. 2.

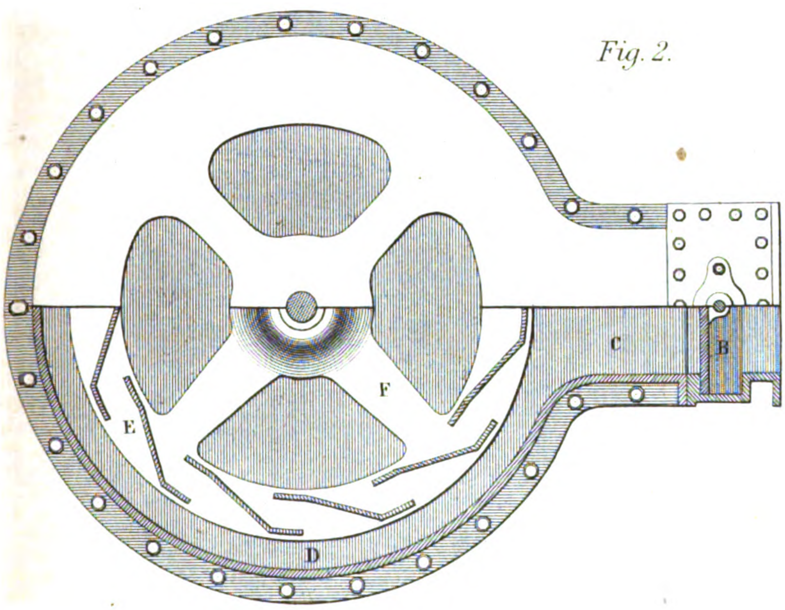


Fig. 4.

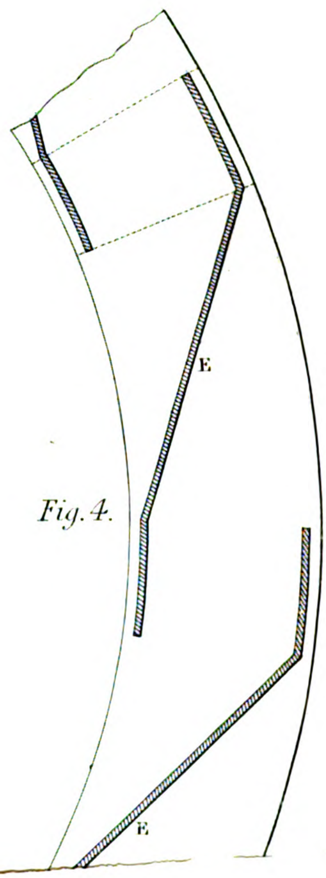
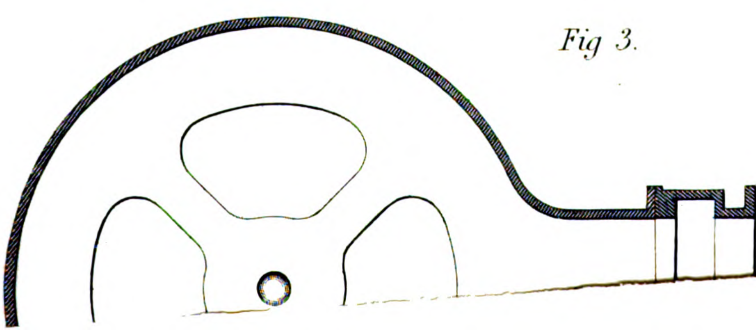


Fig 3.



though the quantity of water may be large, the height of fall may be but a few feet. The water, acquiring a velocity from rushing down an inclined race, strikes the float-boards near the bottom of the wheel, and communicates to the machinery a portion of its own motion. Now this Undershot Wheel is a most imperfect machine. In the Overshot Wheel, the theoretic value of water is equal to its weight multiplied by its height of fall, and of this force, two-thirds may be taken as the average actually available in practice. In the Undershot Wheel, on the other hand, the theoretic power is but half the weight of the water multiplied by its height of fall; and of this scarcely more than one-half is available in practice. Hence the final performance of the Undershot Wheel is less than one-third of the total theoretic power of the water expended. From its gross want of economy, this machine should never be used where any other is practicable.

The Breast Wheel has float-boards like the undershot, but instead of moving in an open race, revolves in a carefully-constructed channel, the sides of which are so closely fitted to its frame, as, with the float-boards, to form in some degree a set of buckets. The water is let on somewhat below the axis, and entering the channel with some velocity, it acts at once by weight and impulse. The power of the breast wheel is intermediate to those of the wheels already noticed. It is, in fact, compounded of the two. The available working effect may be taken at 55 per cent., or little more than half the calculated force of the water.

Of the Horizontal Wheels, the Tourbine is the most improved form. It is an engine of remarkable efficiency, invented in France about a century since, by M. Fourneyron. The Tourbine is a horizontal wheel, furnished with curved float-boards. On these the water presses from a cylinder which is suspended over the wheel, the base being divided by curved partitions, that the water may be diverted in issuing, so as to produce upon the curved float-boards of the wheel its greatest effect. The construction of the machine is simple; its parts not liable to go out of order; and as the action of the water is by pressure, the force is under the most favourable circumstances for being utilized.

The effective economy of the Tourbine, when well constructed and judiciously placed, considerably exceeds that of the overshot wheel. But this economy in the Tourbine is accompanied by some conditions which render it peculiarly valuable. In an ordinary water-wheel you cannot have great economy of power without very slow motion, and hence, where high velocity is required at the working point, a train of mechanism is necessary, which causes a material loss of force. Now, in the Tourbine, the greatest economy is accompanied by rapid motion, and hence the connected machinery may be rendered much less complex. In the Tourbine, also, a change in the height of the head of water alters only the power of the machine in that proportion, but the whole quantity of water is economised in the same degree. Thus, if the Tourbine be working with a force of ten horses, and its supply of water be suddenly doubled, it becomes of twenty horse power; if the supply be reduced to one-half, it still works five horse power: while such sudden and extreme changes would altogether disarrange water-wheels which can only be constructed for the minimum, and allow the surplus to go to waste.

But, in addition to these advantages, the Tourbine possesses others, which, when it is used as a tidal wheel, are altogether unique. The acting force in the Tourbine is proportional to the difference between the pressure of the water inside and outside of its cylinder. It is no matter how deep it may be under water, provided this difference is kept up. It works with the same effect; delivers out in practice the same per centage of the theoretic power; and hence realizes absolutely the chief conditions necessary for the perfect utilization of the motive power of our tides. The Tourbine is, therefore, peculiarly the machine for economising tidal power, although, it must be remarked, it will only work with one flow of the tide.

Our Plate 72, represents four views of the double-acting balanced pressure-wheel. It has been recently patented by John Gwynne, Esq., of Lansdowne Lodge, Notting-Hill, London, and, as will be seen from our illustrations, is a modification of the Tourbine.

Fig. 1 is a vertical sectional elevation of the wheel, with its regulating valve. Fig. 2 is a plan, partly in horizontal section. Fig. 3 is a plan of the casing and regulating valve-chest detached; and fig. 4 is an enlarged detail of a portion of the bucket ring. In this arrangement, the wheel is intended to be worked by the rise and fall of tidal waters. If adapted for streams, the bottom case is removed, and the water, after entering the wheel, falls through the opening into the tail race. The water is admitted from the level, A, by the regulating slide valve, B, to the water-way, C, in communication with the annular space, D, round the wheel. This case encircles the ring of buckets or partitions, E, for the ingress and egress of the water to work the wheel either way of the tide. These partitions are carried by the arms, F, fast on the vertical shaft, G, which passes upwards to drive the machinery.

The peculiar feature of Mr. Gwynne's invention, consists in the shape of the partitions between each water-way, which are so arranged as to present a direct surface to the action of the water in its passage through, whether the water passes from the level of the dam, A, to the tail race, or the reverse. The annular space, E, containing these partitions, is cased at top and bottom, both surfaces being turned true in the lathe, and working the one against the lower, and the other against the upper surface of the annular casing. When employed as a tidal wheel, the patentee forms the connection between the main spindle and the first motion horizontal shaft, by an arrangement of three bevel wheels with an adjustable clutch-box, for accommodating the direction of motion of the gearing to the reverse motion of the wheel, when the tide turns. The variation in the rate of the wheel, due to the varying head of water as the tide rises or falls, is compensated for by a double-cone pulley action, actuated by a float working on the head water level; as the rate of the wheel decreases from the diminished head of water, the fall of the float changes the relative position of the strap on the cone pulleys, in order to give the driving shaft a higher proportionate speed. The patentee gives the following comparative table, showing the economy of this form of Tourbine.

Wheel.	Economy of Power.
Undershot	about 33 per cent.
Breast	" 55 "
Overshot	" 70 "
Tourbine	" 80 "
Gwynne's Double-acting	" 85 "

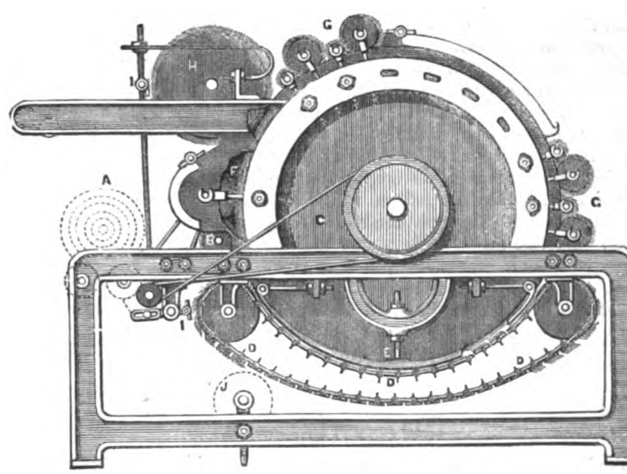
The simplicity of Mr. Gwynne's wheel is a most important featur in its favour, whilst the facility with which it can be adapted to be worked efficiently by the constantly varying head of tidal waters, opens up to us, as it were, a new source of power, as yet quite untouched.

IMPROVEMENTS IN TEXTILE MECHANISM.—LEIGH'S CARDING ENGINES AND LAP MACHINE.

Mr. Evan Leigh, of Miles Platting, near Manchester, has recently patented an extensive series of improvements in cotton machinery, from which we have selected two examples in illustration of the present paper. In carding engines, he employs an endless travelling sheet of cards or flats, as they are termed by the practical cotton manufacturer; the cards upon them being set in transverse strips, with intervening spaces. He also uses travelling flats beneath the main cylinder, and a "fancy roller" for stripping the latter, with only a portion of the cloth, furnished with cards.

Fig. 1 of our engravings represents one of the improved carding

Fig. 1



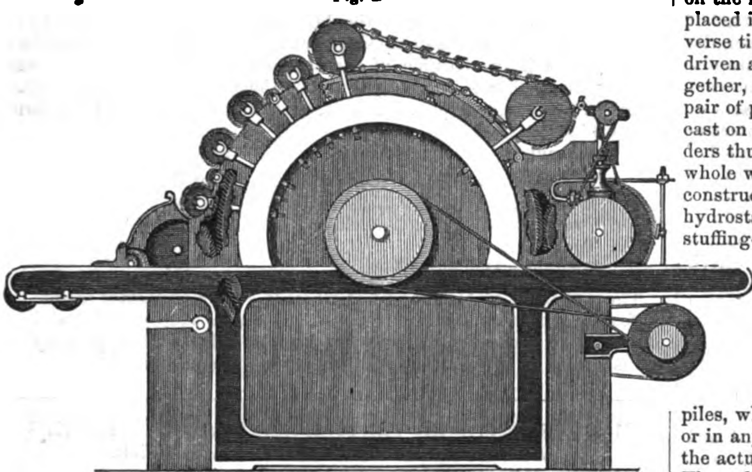
1-24th.

engines, which, whilst built to perform a large amount of work, is only about six feet in length. The cotton is fed direct from the lap, A, by the feed-roller, B, to the main cylinder, C, and is carried downwards beneath it. The revolving flats are shown at D D; they are nineteen in number. E, Is a flexible bend for setting the flats accurately to the main cylinder; the flats being regularly stripped in their traverse, as an endless chain, by the comb, I. In their revolving movement, they not only card the

cotton passing through the engine, but bring up all the motes and "fly" to be stripped off by the doffing knife or comb, I. The upper part of the cylinder may have as many rollers and clearers as will cover it, or simply a cover to lift up for grinding. When the cotton has passed the doffer, H, the cylinder is acted upon by the "fancy roller," F, which overruns its periphery. This roller is only clothed with a single sheet, or strip of card, wound round it once in a spiral direction, and has the effect of snatching or raising a piece of cotton from the cylinder at every revolution, depositing it on the feed-roller, B. The action of the latter roller prevents the cylinder from getting choked. The dotted circle, J, represents the place where the grinding rollers may be adjusted.

Fig. 2 is a similar view of an ordinary carding engine, as altered to

Fig. 2



1-24th.

Mr. Leigh's improvements, and exhibiting the action of the self-stripping flats on the upper side of the cylinder, this application being very simple and cheap.

The principal features of novelty in this class of engine, are the "flexible bend;" the application of revolving flats beneath the cylinder; the introduction of flats hinged by their centres like a Venetian blind, so as to make it practicable to set them to any bevel whilst sliding over the bend, and acting upon the cotton; the stripping action upon the flats by a comb; and the fancy roller, with only one card or strip of brush upon it. In addition to these points, its extreme simplicity, and small first cost, are too important to be neglected in the calculations of the practical spinner.

It is undeniable that the carding process is the most delicate of all the operations in a cotton-mill. If it is inefficiently done, no after-care can remedy the evil; and Mr. Leigh has done well in directing his attention to a branch so strongly affecting the production of good yarn. The same inventor has also introduced a novelty in the lap machine, for making finisher laps. He employs a tapering feed-table, furnished on each side with calender rollers, which take up the slivers from the cans, and passing them through conductors, deposit them side by side on the table. By this mode, a lap of any width may be made without involving a confusion of cans. When a given length has run on, the lap breaks off, and when removed, it is weighed, any irregularity which may be detected, being regulated in the next, by breaking down, or adding another sliver.

SCOTT'S HYDROSTATIC DRY DOCK AND KEEL-BLOCKS.

(*Illustrated by Plate* 73.)

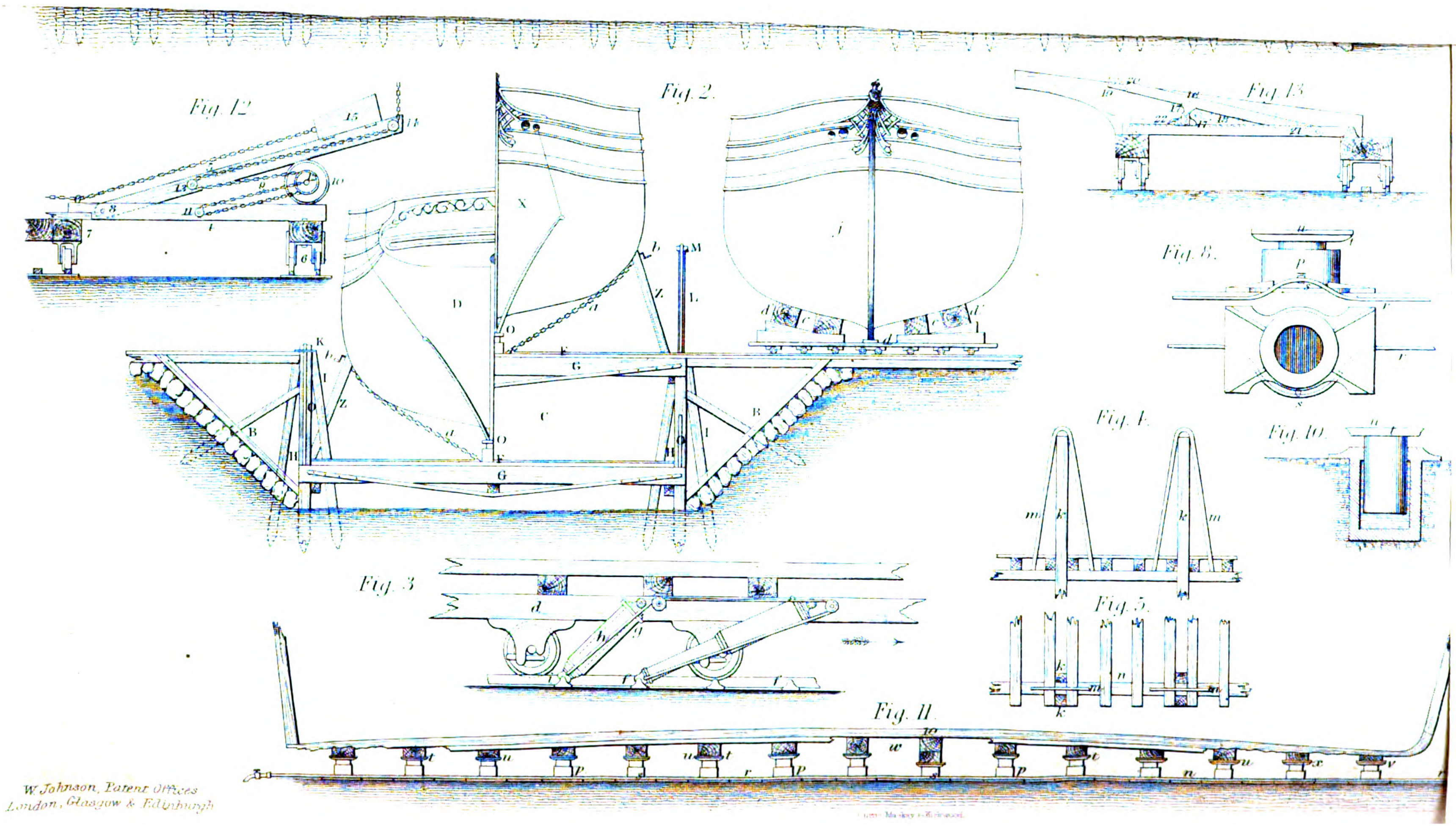
We have already given a brief notice of this very important invention,* which our illustrative plate enables us now to detail more fully. The inventor, Mr. James Scott, of Falkirk, an experienced practical shipwright, has directed his attention, in the first place, to the production of an economical substitute for the ordinary docks and slips; for the particulars of which, we may at once refer to the several figures on our plate.

Fig. 1 is a vertical longitudinal section of the proposed substitute for the ordinary dry dock, with the ship-lifting apparatus attached, showing two transverse sections of a vessel at different levels in the dock, and a stern section of another as run off from the dock platform on to dry elevated ground. Fig. 2 is a transverse vertical section through the dock, with stern and bow views of longitudinal sections of a vessel in it, with a front or bow view of another in the act of being run broadside off landward.

In this arrangement of dock, or substitute therefor, the whole of the works may, in many situations, be fully carried out without involving any excavation whatever. In the present example, A is the open river or harbour, and B B B the side and end walls or banks of the excavated area, C, cut into the land, of a sufficient length to receive the largest ship to be raised in it. The stern section, D, of the vessel, is represented at the level of its flotation, just preparatory to its elevation, its keel resting on the row of common wood keel-blocks, E E. These keel-blocks are placed in a continuous line upon the platform, F, supported by the transverse timber beams, G. Along each side of the dock, or excavation, are driven a row of piles, H, trussed longitudinally, placed in pairs near together, and supported by inclined piles, I. In the space between each pair of piles is placed a long hydrostatic cylinder, J, having a flange, K, cast on its upper end for resting upon the heads of the piles. The cylinders thus hang down between each pair of piles, which latter bear their whole weight and strain in working. These hydrostatic cylinders are constructed, in every respect, like the same parts as used in ordinary hydrostatic packing-presses, being fitted with rams, L, passed through stuffing-boxes, in the upper ends of the cylinders. These rams are fitted with saddle-heads, M, on their upper ends, to fit into the bends, N, of the straps or double connecting-rods, O O; the bends of these rods thus rest on the tops of the ram saddles, and the lower ends of the rods are bolted, or otherwise attached, to their corresponding transverse beams, G, beneath. By this arrangement the entire weight of the vessel is thus communicated from the platform and keel-blocks to the rams, L, and thence to the piles, which carry the whole apparatus. At the landward end of the dock, or in any other convenient position, a timber stage, P, is erected to carry the actuating water-pump, Q, for giving motion to the hydrostatic rams. The cylinder or barrel of this pump is placed horizontally upon a bracket or pedestal, R, on the platform, S, of the timber stage. The pump piston is worked by the rod, T, guided in the bracket guide, U, from a crank or eccentric on the shaft of the fly-wheel, V, which may be driven either by a winch-handle or by steam. From the bottom of the pump barrel, Q, a pipe, W, of small bore, passes alongside each row of hydrostatic cylinders, carrying the vessel's platform, and a communication is thus formed between each cylinder and the pump, by branch pipes opening out from the pipes, W, into each cylinder. When a vessel is to be elevated in this dock or excavation, she is floated into it from the river or harbour, until she comes over the keel-blocks, or directly over the platform, F, to the position represented by the stern section, D. The pump, A, being then put in motion, water is forced by it through the pipes, W, and from them into each of the hydrostatic cylinders, J. As each cylinder acts like an ordinary press, it is obvious that the simultaneous rise of the double row of rams will carry up the platform, and with it elevate the vessel directly upwards by a perpendicular lift, when her hull may be examined, and, if necessary, any slight repair may then be executed. If extensive repairs are required, the ship is then lifted up high enough for being tranferred to the shore.

The bow section of the vessel, X, is represented as having reached the summit of its vertical rise, the hydrostatic rams having been forced upwards correspondingly by the pumping action. The ship is thus supposed to have risen to the level of the pier or river-bank, Y, to which it is to be run off, as into a building-yard for repair. The ship is described as resting only on its keel, on the line of supporting blocks carried on the platform; but it is, in addition, held up at the bilges by a row of shores, Z Z, on each side. These shores are peculiarly arranged and constructed, so as to give their support to the ship, partly in themselves, and partly through their adjusting chains, *a*. The shores, or supports, are attached at intervals by hinge bolts, at their lower ends, to the timbers of the platform, F. The adjusting chains, *a*, are fastened to the centre of the platform under the vessel's keel, and are linked at the other to a hook on the end of a short screw-spindle carried in the head of the shore, and worked by a winch, *b*. When the platform is empty, the rows of shores are turned back upon their hinges to a vertical or inclined position, at or near the lines of piles, H, so as to leave the platform free. When a ship is to be placed on the platform, the shores are inclined forward so as to bring their ends against the bilges of the ship, as represented in fig. 2. The chains, *a*, are then attached to their screw-spindles, and are tightened up by the winch-handles, *b*, until a firm support is given to the bilges, by the combined action of the ends of the shores, and the chains embracing a portion of the bilges. When the ship is to be run

* See *ante*, Page 12, Vol. III.



W. Johnson, Patent Offices
London, Glasgow & Edinburgh

off the platform on to dry land, she is shored up by blocks and wedges placed in the usual manner beneath her bottom, as delineated for example at *c c*, in the bow view of the ship passing broadside from the dock in fig. 2. These supports ease off the weight from the line of keel-blocks, in readiness for the transfer of the weight from the platform to the traversing carriage, *d*, represented in fig. 1 as having just received a ship. This traversing carriage consists of three or more lines of beams, supported on traversing wheels, running on corresponding rails laid down on the pier or shore, a similar set of rails being also laid down on the platform, F, to correspond. The carriage being traversed forwards upon the platform rails, so as to come beneath the ship's bottom, and the keel-blocks and bilge-supports lowered or removed, the ship is allowed to come down upon a set of keel-blocks on the carriage, being also supported laterally by shores, *e e*. These shores are supported on the carriage, and fitted with adjustable supporting chains, as in the same details of the platform, F, of the dock. The ship is now in a position to be traversed off the platform, and this movement is effected by a hydrostatic pressure apparatus attached to the carriage. The arrangement of this apparatus is shown in detail in fig. 3.

By the side of one or more of the continuous lines of rails fixed on the platform and on the ground, is formed a serrated rack, or a series of fixed studs, to suit either the backward or forward movement of the carriage; and to the corresponding beams of the carriage, *d*, is hinged a hydrostatic cylinder, *g*, the ram, *h*, of which carries on its outer end a catch or detent, *i*, arranged to fit to the serrations of the rack, or to the studs, *f*, whichever may be used. The detail, fig. 3, represents this apparatus in action. Water being pumped into the cylinder, the ram is forced outwards, so as to press its detent against the rack-teeth, or against the studs, *f*, and the reaction of this pressure upon the carriage causes the latter to traverse in the direction of the arrow. The traverse is thus effected in a series of movements, the ram being drawn back after each extension, by means of a suitable counterweight hung to a chain attached to the ram, and passing round a pulley on the carriage. By employing a second cylinder-ram, a continuous progressive movement is obtained, and the use of a counterweight obviated. The chain is secured to each ram, so that, as one is making a stroke, the other is being drawn up in readiness for the next traverse. When the ship has received the necessary repairs, she is returned to the platform, by reversing the ram on the studs or rack-teeth, and allowed to descend to the water by a discharge of the water from the elevating cylinders. In addition to this longitudinal traverse of ships, it is obvious that they may be removed broadside, or laterally, by a precisely similar process. The bow elevation, *j*, in fig. 2, shows a ship so removed, being held up on the traversing carriage by blocks and wedges, *d'*, instead of by shores at the bilges. Figs. 4, 5, 6, and 7, represent another modification of the elevating platform of the dock. Fig. 4 is a side elevation of a portion of the platform, piles, and supporting-rods. Fig. 5 is a plan corresponding. Fig. 6 is a transverse section of the pier, showing the piles, with the platform and shores, as having a ship upon them; and fig. 7 is a similar section, with the ship and shores removed. In this arrangement, the pairs of piles, *k*, are set transversely in reference to the length of the platform, and the hydrostatic cylinders, *l*, are placed between them, their connecting-rods, *m*, being attached to the longitudinal beams, *n*, instead of to each transverse beam. In this way the transverse beams act as guides, by sliding upon the pairs of piles; and as the cylinders are independent of these beams, they may be placed at wider intervals.

In the elevation, fig. 1, the ship is shown as supported on the ordinary timber keel-blocks, E E; but in figs. 2 and 6, is shown the adaptation of Mr. Scott's improved hydrostatic keel-blocks, as at *o o*, in these figures. In order to give a clear explanation of these blocks, we may now refer to the several figures 8, 9, 10, and 11. Fig. 8 is an elevation of a single block, with a corresponding plan of the cylinder, with the ram removed. Fig. 9 is a vertical sectional elevation of one of the cylinders, with the ram in elevation, and a corresponding plan of the complete block, with the ram in its place. Fig. 10 is a vertical section of a cylinder of longer stroke, as sunk in the floor of the dock, showing also the ram in elevation; and fig. 11 is a longitudinal elevation of the "hog-backed" keel of a ship, as supported on a line of the hydrostatic keel-blocks. Each block is formed like an ordinary hydrostatic press of short stroke, the cylinders, *p*, having broad flanged bases for supporting them upon the platform or floor of the dock, or lifting apparatus. Water is supplied to the cylinders from the pump, *q*; a pipe, *r*, from which passes along the line of blocks; a stop-cock, *s*, and a short branch being fitted at each cylinder to afford the means of making and cutting off the water communication. It is obvious, that when water is pumped into these cylinders, all the rams, *t*, will rise to one uniform height; and when the water is shut in by closing the main supply stop-cock, the platforms or upper flanges, *u*, on the tops of the rams, will form a firm support for a ship's keel.

When a ship, with a keel hollowed or "hog-backed," as in fig. 11, is thus brought over the line of blocks, and touches any one of them, as at *v*, the pressure thus communicated to the ram of this cylinder will force the water from it, to such of the others as are yet unacted on, or to those, the rams of which are too low to receive the ship's weight. As an example, the convexity of the keel at *w* would prevent its resting upon the ram at that point, but the initial pressure upon the ram, *v*, and such others as *x*, which might also be acted upon, would cause a flow of water into the cylinders yet untouched, until their rams rose and took their share of the weight. By grounding in this manner, the vessel cannot be strained, however uneven its keel may be, the keel line being left precisely as it is whilst afloat. Any one or more of the blocks are removeable at pleasure; and this facility of adjustment renders their use very advantageous for repairing a ship's copper, or giving her a false keel. When adopted for the ship-lifting apparatus, instead of the timber blocks, E, they afford very great facilities for the reception and removal of the ship from the platform, as by pumping up the rams, or letting off a portion of the water from the cylinders, the inconveniences of the ordinary plan of wedging up and letting down by blocks and wedges are totally removed. The view of the keel with its line of blocks, fig. 11, explains the process of lifting a ship direct by these blocks. When the rams have been elevated a short distance, the whole of the cylinders are to be cut off from their communication with the main pipe by their stop-cocks, *s*, with the exception of one or more at intervals along the line. The stop-cocks of these being left open, the water from them may be discharged by a stop-cock at the end of the main pipe, *r*, or returned to the cistern whence the pump is supplied. This allows the rams of such cylinders to fall, when blocks may be inserted between their tops and the bottom of the ship's keel, when the pumping action may go on as before to elevate the whole series of rams. By a repetition of this process, and the gradual insertion of elevating blocks, a very considerable rise may be given to the vessel with rams of short stroke.

The next branch of Mr. Scott's improvements refers to a modification of the common timber arm for the traversing apparatus of slips. In this plan, the arm, instead of being firmly bolted to the carriage timber, is simply held by a swivel bolt, so that it may be laid parallel with the timber when the carriage is run beneath the vessel, and as it is never disconnected from the carriage, the labour of removing and attaching the common arm is avoided.

Fig. 12 exhibits an arrangement of wooden or iron arm, as fitted with the improved adjustable apparatus for setting the arm. The arm is in this arrangement formed of two lengths, 4, 5, each being made out of two parallel beams or bars, connected by transverse end pieces. The horizontal length, 4, turns on a swivel joint, 6, on the outside side timber of the carriage, and is adjustable at 7 by bolts or other connections to the centre of carriage, when placed for carrying a vessel. The other length, 5, is jointed at 8, to the horizontal length, 4, and is adjustable to the required angle by the chain, 9. A roller, 10, acts as the adjusting medium for the angle or height of the arm, 5, being arranged to traverse towards or from the line of the angle of the floor of the ship, along the horizontal arm, 4, and press up or lower the arm, 5, correspondingly. The chain, 9, is attached at the axis of the roller, 10, thence it is passed round the fixed guide pulley, 11, and round the smaller diameter, 12, of the roller. From this point it passes round the fixed guide pulley, 13, in the arm, 5, and is then turned back, and finally passes round the guide pulley, 14, and up to the ship's deck, or other point whence the chain or rope is to be worked. The adjustable supporting wedge carried on the arm, to bear against the ship, is at 15, being connected by a chain passing beneath the ship's keel, to the opposite corresponding wedge.

Another modification of arm is delineated in fig. 13. This arrangement is similar to that last described, excepting that, instead of employing a traversing roller to adjust the angle of the arm, 16, a double traversing chock or wedge block, 17, is used. The two pieces of this chock are connected by a hinge joint, 17', the spindle passing through which affords the means for attaching the end of the chain, 18. The opposite end of this chain is passed upwards as described in reference to fig. 12, round the guide pulley, 19; and to afford additional power, the two pulley blocks, 20, 21, are adopted in place of fixed guide pulleys. As this double chock is traversed in or out to adjust the angle of the arm, the central joint, 17, allows of a self-acting adjustment of the supporting surfaces of the two pieces, to any angle to which the arm may be raised, whilst the paul or detent, 22, taking into a serrated rack on the horizontal arm, prevents the chock from being forced outwards by the weight which it may be supporting.

Mr. Scott's admirable system of keel-blocks is getting rapidly into use both in England and Scotland. Mr. Somes, the eminent Thames builder, has just had a set to carry a keel of 250 feet; and in Scotland, Mr. Stevens has adopted them at Kelvin Dock, on the Clyde.

THE MECHANIC'S LIBRARY.

Animal Magnetism, Letters on, post 8vo, 9s. 6d. Dr. W. Gregory.
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Ship-Building, Theory and Practice of, 2nd edition, 16s., plates. White.
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RECENT PATENTS.

JACQUARD MACHINERY AND FIGURED MUSLINS.

HUGH MAIR, ESQ., *Glasgow.—Enrolled May* 11, 1851.

The first portion of Mr. Mair's invention has reference to a peculiar mode of attaching or connecting the cords of the Jacquard needles to the threads of the warp in the loom. Instead of making this connection so that the first cord shall draw or actuate the first thread, and the second cord the second thread, and so on in the same sequence throughout the entire tie, as ordinarily practised in the full harness, he arranges the connection so that one cord shall draw or actuate two or more warp threads. That is to say, the first cord draws the first and third warp threads, and the second cord the second and fourth warp threads, this sequence being continued throughout. It will be obvious to the practical man, that, as each needle of the Jacquard apparatus thus actuates two warp threads, the detail of the interweaving of the threads of the fabric under operation will be made coarser to a corresponding extent. This system of weaving has the effect of modifying the surface or external appearance of the fabric, so as to produce an improved effect in certain classes of figured muslins, such as those used for window curtains and others.

The economy gained by this arrangement amounts to a saving either of one-half the number of cards, or gives the power of producing the pattern with cards of one-half the size which would be necessary for the production of a given pattern in the ordinary manner. Or, in other terms, a pattern may be produced by it of twice the size of that producible by the same number or extent of cards in the ordinary way.

Instead of this plan, the first cord may be made to actuate the first, third, and fifth threads; the second, the second, fourth, and sixth threads; or, a still greater number of warp threads may be connected to one needle cord, always preserving the alternate plan of connection. In this way, the economy in the number or extent of the cards, or the extent of the pattern with the same cards, may be increased to any extent, limited only by the corresponding increase in the coarseness of detail of the fabric so produced.

The same system is obviously applicable to the Draw-Loom, by similarly attaching the simples or the tails to the warp threads. In both the modifications described, the alternate plan of attachment is used; but this is not essential to the working out of the system. Instead of such a sequence, a differential alternate plan may be adopted; that is, the first cord may actuate the first, third, and fourth threads; and the second, the second, fifth, and sixth threads, or by any other suitable differential alternation.

The same harness is applicable to the patterns now made with the common harness, producing the figure on the fabric, with an embossed or flushed surface, similar to that produced by the full harness, and on the same side of the fabric.

The second head of improvements, comprehends another arrangement for economising the pattern cards; and consists in giving the cards, at the required intervals, a longitudinal movement along the faces of the needles, so that the same card may be made to produce two or more distinct shades or shots of the pattern. This movement is effected by a treadle working a crank or lever, pressing against one end of the spindle of the barrel or cylinder, on which the card in operation is placed. This treadle action causes the card of the flower or device to traverse along the needles, so as to bring all the holes of such flower or device, which are cut in the card, opposite the needles next in order, or any other set of needles, not being those on which the card has just been acting. It is obvious that this shift has the effect of producing a shade or shot, distinct from that made by the card previous to its being shifted, and thus the weaver is enabled to make two shots or shades by means of the one card, and effecting an economy of one-half the number of cards ordinarily used. Each card has a duplex action of this nature, the only effect upon the fabric so woven being, that the threads of the pattern or device are carried or thrown to the extent of one or more loops or threads to one side. In this arrangement, the harness is tied longitudinally or along, instead of transversing it across the rows of cords as is usual.

This improvement is applicable to the full harness, the gauze harness, the split or common harness, or any other modification, when tied longitudinally instead of across the rows of cords of the machine.

In the north side of the western nave of the Great Exhibition, may be seen a very beautiful example of muslin window curtain, woven according to this process, by Messrs. Mair, Son, & Co. The device, a vase, with double floral festoon, is deserving of marked commendation.

REGISTERED DESIGNS.

CLEAR WAY VALVE.

Registered for MR. J. B. DAVIS, *Russell Street, London.*

The name which Mr. Davis has chosen for his invention, in itself indicates the point of improvement, namely, the securing a clear waterway, an object of no easy attainment in ordinary stop-cocks. In the engravings, fig. 1 is a side elevation of the valve, and fig. 2 is a corresponding longitudinal section. In this example, it is represented with screwed connections, but it is obvious that it may be made in a variety of ways to suit any particular purpose, such as with tinned ends for a stop-valve, or with a bib-nose, flanges, or sockets.

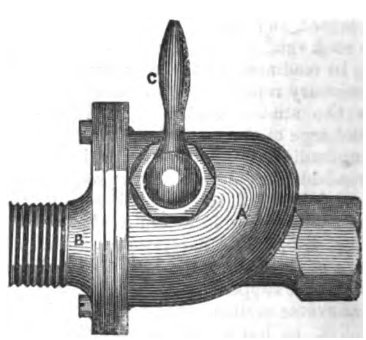


Fig. 1.

The end, A, is the inlet, the discharge being by the passage, B; the two divisions being held together by bolted flanges. The part, A, of the shell, has formed upon its side a stuffing-box to receive the short horizontal spindle employed in actuating the valve, the movement being communicated by the lever-handle, C. This spindle has a square upon it, and on this part is placed the short lever, D, which enters a slot in a tail-piece cast on the valve. The valve is simply a metal disc, faced with vulcanized india-rubber, held on by a screw on the face side. It is supported by two side arms bored out at their upper ends, with oval holes, by which it is suspended from the actuating spindle above, the oval being necessary to allow the valve to have free motion on its spindle. In the section, fig. 2, the valve is delineated as closed; to open it, nothing more is necessary than to bring down the lever, C, towards the outlet end, when the valve will be raised clear off its seat, giving a full and direct water-way.

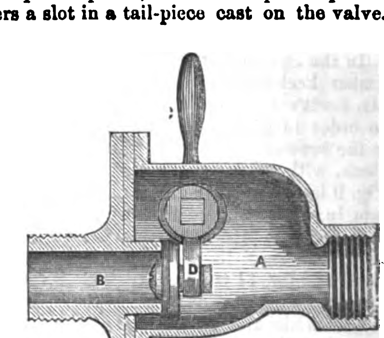


Fig. 2.

With this kind of seat, the valve is only suited for cold fluids. For hot water, or steam, the india-rubber face must be replaced by a conical metallic face ground to fit. The inventor states that the range of sizes of this valve extends from ½ inch to 12 inch bores.

SOLE TO COVER TYRES OF CARRIAGE-WHEELS.

Registered for Mr. John Hadley, *Coachbuilder*, *Worcester*.

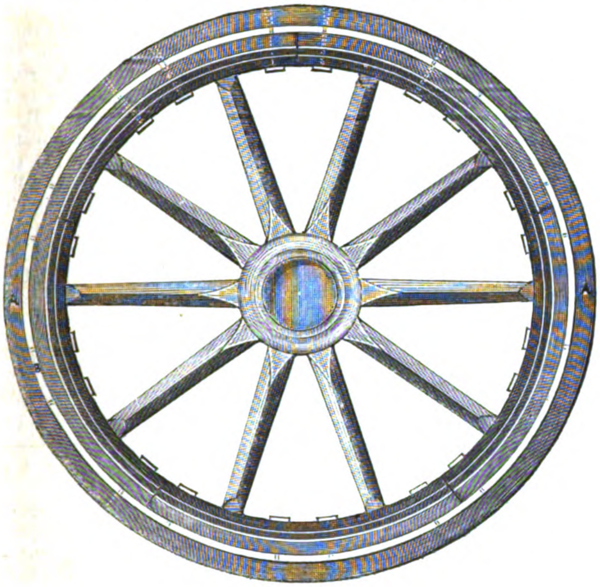


Fig. 1.

Mr. Hadley proposes in this design to furnish an economical mode of repairing worn and rickety wheels. The plan, which certainly possesses the merit of simplicity, is clearly set forth in our four illustrations.

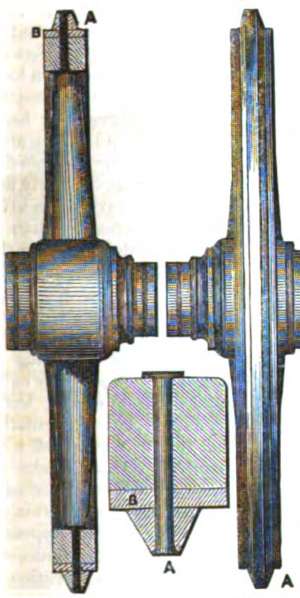


Fig. 2. Fig. 4. Fig. 3.

Fig. 1 is a side view of a carriage-wheel complete, with the sole attached. Fig. 2 is a corresponding edge view of the wheel, with the felloes in section. Fig. 3 is a similar external elevation; and fig. 4 is a transverse section of a felloe, tyre, and sole, on a larger scale. The first three figures are one-sixth the real size; the fourth is half size. The new sole, A, is bolted over the periphery of the tyre, B, by a ring of bolts, two between each pair of spokes. The sole may be either iron or steel, and its section is fully delineated in fig. 4. By the addition of the sole to an old wheel, the latter may be rendered quite stout and firm, whilst the cost of the ordinary process of removing felloes and tyre is saved.

ENLARGED HEATING SURFACE BOTTOM FOR COPPERS.

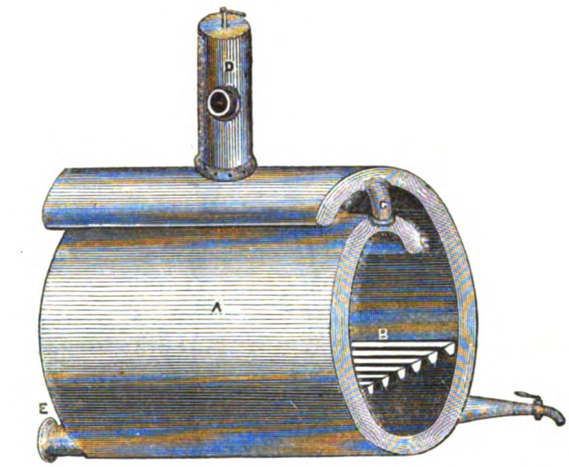
Registered for Messrs. Perkins & Sharpus, *Bell Court*, *London*.

This is an ingenious application of the principle of corrugation to the bottoms of coppers, kettles, and other utensils for heating fluids. Instead of a plain flat bottom, Messrs. Perkins & Sharpus stamp a flat sheet into circular or elliptic corrugations, according to the contour of the vessel. The cost of this modification is extremely trifling, whilst it is obvious that a very large increase of heating surface is gained by it, and the heated vapours are retained longer in contact with it. As an example of the extent of the improvement, it may be mentioned that a three-quart vessel is made to present as much heating surface as the bottom of a six-quart made in the ordinary way, and the boiling is effected in two-thirds of the time.

CONVOLUTE BOILER.

Registered for Messrs. Garton & Jarvis, *Exeter*.

This boiler is intended for heating conservatories or public buildings by steam, or the circulation of hot water. Our engraving represents the boiler in perspective, with the fire-doors removed. The boiler, A, is of the convolute form, having the grate-bars, B, within it. It is made either of wrought or cast-iron or copper, the water space between the two parallel sheets of metal forming the volute, being three inches in breadth. The course of the draught is very obvious; it passes from

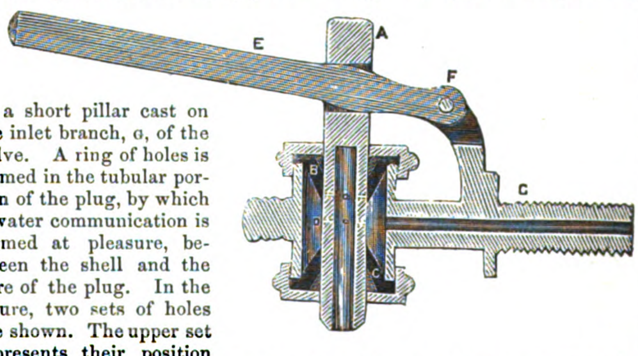


the interior of the convolute out by the open overlap, and then completely round the exterior of the boiler, which is surrounded by brick-work to form the external flue. The pipe, C, forms the water communication between the body of the boiler and the crown. The heated current of water flows off to the locality to be warmed, by the pipe, D, and the heavier cooled water returns by the bottom pipe, E. It will be seen that the peculiar feature of this arrangement, is the effective mode in which the entire internal and external surfaces are exposed to the action of the heat. Several boilers on this principle are in the Exhibition.

STOP-COCK.

Registered for Messrs. Stock & Sons, *Birmingham*.

Messrs. Stock & Sons propose to diminish the risk of leakage in valves of the stop-cock class, by the adoption of double conical leather-washers for the working surfaces, instead of metal. Our engraving shows the new cock in vertical section. The plug, A, is hollow through the greater part of its length, its upper end being solid, and having an eye formed in it for giving it motion; B, C, are two conical leather-washers contained in the chamber, D, the two end covers of which are bored out to admit the plug, such covers answering to hold the two washers. The plug is actuated by the hand-lever, E, passed through the eye, and hinged at F,



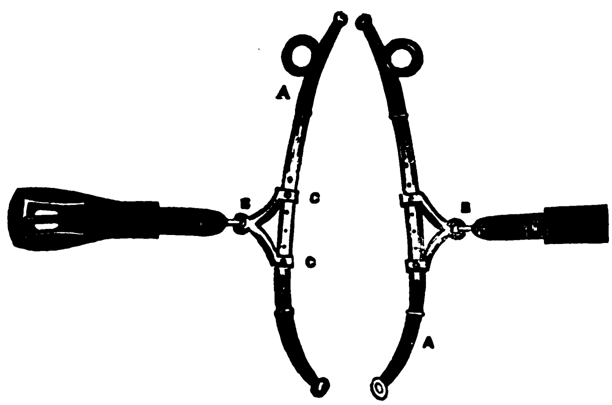
to a short pillar cast on the inlet branch, G, of the valve. A ring of holes is formed in the tubular portion of the plug, by which a water communication is formed at pleasure, between the shell and the bore of the plug. In the figure, two sets of holes are shown. The upper set represents their position when the valve is closed by the elevation of the plug and lever, so that the upper leather cone, B, shall envelope the holes, and thus close the communication with the interior. The lower set is added to the sketch, to show how the descent of the plug, consequent upon the depression of the actuating lever, uncovers the holes, and allows the fluid to flow from the shell, and escape by the open lower end of the plug, which is the outlet

of the valve. If the plug is pushed lower down, the holes will be similarly enveloped by the lower cone, C, so as to stop the flow, the valve being full open only when the lever, B, is horizontal. As the shell is always full of water, whatever fluid pressure may be exerted, can only tend to press the leather cones into closer contact with the surface of the plug, and resist all leakage.

HAME.

Registered for MR. R. M. VICK, *Gloucester.*

Mr. Vick's improved hame is designed for the same end as the older invention of Mr. Minshull,* but the idea is carried out under another form. The engraving is a front view of a pair of hames, with the draught straps extended. The blade, A, of the hame, has in it a line of holes extending along the central portion, and the tug eye, B, is thus made adjustable at any level, by screws in the ends, C, of the forked



pieces. In this way, the groom can at any time remove the draught pressure up or down, and ascertain the best point of draught with very little difficulty. By his row of holes at regular distances, Mr. Vick attains great nicety of adjustment. In Mr. Minshull's hame, to which we have referred, the link piece on the hame is bent in easy curves to form three distinct divisions, giving a choice of three points of draught.

CIRCULAR FILE OR CUTTER DRIVEN BY MECHANICAL POWER.

Registered for MESSRS. S. COCKER & SON, *Sheffield.*

A most useful shaping tool has just been introduced under this title, by Messrs. Cocker and Son, of the Porter Steel Works, Sheffield. It consists of a series of separate cutters, built together upon a circular disc, so as to form a circular cutter. It is fitted on the overhanging end of a horizontal shaft, driven like a lathe mandril, and answers excellently for most of the purposes where the hand file is ordinarily used. The set of cutters are removeable at pleasure for sharpening on the grindstone; no softening being required, as is the case with rose cutters which are sharpened by the file.

In many respects the plan resembles Mr. Bodmer's admirable circular cutter for wheel-teeth. It is evident, that where a large extent of plain surface is to be reduced, this cutter must be a very economical tool.

CORRESPONDENCE.

THE ROTATION OF THE EARTH.

The experiments of Foucault, and the results he has deduced from them, form, without doubt, one of the most remarkable discoveries of the present age, and the more so, as they appear to have taken the whole scientific world by surprise. From the profound mathematician and astronomer, to the sound and intelligent practical mechanician, all, I believe, have betrayed incredulity at the idea of a simple pendulum set in motion by the hand, and then left to itself, being capable of demonstrating directly the rotation of the earth. Such, however, is the fact. The pendulum, instead of continuing to move in one determined direction, as hitherto universally believed, is seen gradually to change the direction of its oscillation. The centre point remains always fixed, but the extreme points to which the ball of the pendulum arrives at the end of each oscillation, change their position by degrees, the point nearest the observer invariably shifting to the left, and the point farthest from him as much to the right, so as to show, in the line joining the two opposite points in the extreme range of the ball, a slow motion round the centre of vibration, and this in the direction of the motion of the sun. If we look farther to the point of suspension, and consider that it also remains and must remain fixed, the whole plane of vibration will appear to have a rotatory motion round the plumb-line, as on a vertical axis. By very accurate measurements, this motion is discernible in one, or at most two, vibrations. But with a long pendulum it soon becomes palpable to the senses, and particularly when we draw on the floor of the room a line to mark out the initial line of vibration. We then see the ball begin slowly to diverge from this line at either extremity, and this divergence gradually to increase, as if, in process of time, it would move like the needle round the whole compass, showing in the plane of the pendulum's vibration an apparent rotatory motion round its axis, but conveying to the reflecting mind, irresistibly and palpably, the wonderful sensation of the true motion of the observer, and all around him, in the opposite direction, in consequence of the rotation of the earth. Having frequently repeated this most interesting experiment since its announcement, and always with the same effects, and shown it to various friends, probably the following results may be interesting to your readers. I regretted not having been present at the lecture on the subject given by my esteemed friend Dr. Lees, and which, from your report, must have been highly interesting.

The experiment I found by no means difficult to make, having the command in the lobby here of a clear height of 30 feet. and the apparatus consisting of nothing more than a ball of metal about 9 lb. weight, suspended from the ceiling by a small brass wire. The greater the height, the longer can the ball be kept in motion without stop or interruption; and the heavier the weight, the more sure are we of being clear of any inequalities arising from the mode of suspension, which should be as firm as practicable. On marking out a line on the floor to show the initial line of vibration, and then giving the pendulum, which was 29 feet long, an oscillation of about 6 or 7 feet, a very few minutes were sufficient to show a slight deviation in the ball from its original position, the nearest point moving to the left, and the farthest to the right—that is when looking southwards—and the vibration in the meridian, the north extremity deviating to the left, and the south to the right; the movement being thus in the same direction with that of the sun, or of the hands of a watch. In the course of twenty minutes, the deviation, measured on a circle five feet three inches in diameter, came to 1½ inches, and increased slowly and gradually at the same rate, being equal nearly to a whole revolution in 30 or 35 hours; and nothing could be more beautiful or interesting than to follow the gradual progress of the pendulum ball oscillating along the different lines of deviation drawn on the floor, and the light from the cupola above shining down and projecting the circular shadow of the ball on the floor; this, as the deviation increases, is seen to oscillate more and more in a lateral direction, traversing right and left across the line of initial vibration. As the pendulum comes to relax its motion, owing to the resistance of the air, it tends often to pass into a motion slightly elliptical, and it then becomes necessary to stop and set it off again; but I found it could easily be kept up, moving truly and deviating regularly, for twenty minutes or half an hour together, and then it was set off with a fresh impulse in the new direction it had acquired. In this way, by successive renewals of the motive power, the motion could easily be kept up till the pendulum ball went round a quarter or half a revolution, or even round the whole circle on different days, and the motion appeared to be pretty uniform throughout. Considering the opposite conditions of the motion of the earth, and of the pendulum when in the direction of the meridian, as compared with the east and west line, some entertain doubts whether the velocity should not be different in these different directions, but I have found no sensible difference. In regard to the exact rate of movement, it would require more continued observations to obtain the true result; and I observed that a considerable difference arises by stopping the pendulum, and setting it agoing again at different intervals. If it is done every ten minutes, during which there is a deviation of nearly 1½ inches on a six feet circle, the motion is considerably quicker than when delayed for intervals of twenty minutes.

In one experiment, continued for an hour and twenty minutes, I found the deviation was 8½ inches, being about 15½ degrees, or at the rate of a whole revolution in 31 hours; but subsequent experiments with the intervals of twenty minutes show rather a slower motion.

Such, then, is the fundamental fact of this great discovery—namely, the existence, in the simple vibrating pendulum, of a slow rotatory motion, round the axis of suspension; and it is extremely remarkable, and shows

* Page 214, Vol. II., P. M. Journal.

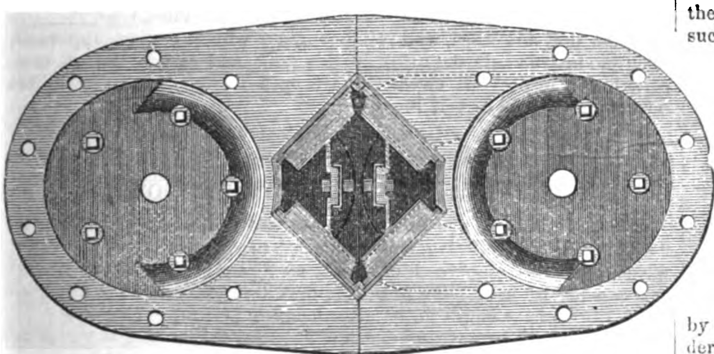
the singular fate of this, as it has been with other discoveries, that the same fact was long ago observed in Italy, and has been found among the records of the famous pendulum experiments made by the Academicians del Cimento in the seventeenth century. This appears from a communication made to the Academy of Sciences in France, since Foucault's discovery has been made known. It is from M. Vincent Antinori, Director of the Museum of Physics and Natural History at Florence, who, having repeated Foucault's experiments, says, that he was naturally led to search the numerous experiments on the motion of the pendulum made by the Academy del Cimento, and of which the record is kept in the rich collection of manuscripts in the Library of the Grand Duke of Tuscany; and there he found the fact related in the following terms, in an unedited note among the manuscripts of Vincent Viviani, who, being a pupil of Galileo, and afterwards of Toricelli, and lived between 1622 and 1703, must carry the date back to 1660 or 1670. "We have observed," says he, "that all the pendulums with a single cord (or point of suspension) deviate from the original vertical plane of vibration, and always in the same direction; that is (giving a diagram), from the right to the left on the anterior side." Thus, it appears, the fact has been recorded, but lain neglected for nearly two hundred years, till rediscovered, and traced to its true cause, by the genius of Foucault. This cause, as explained by him, is not difficult to comprehend, particularly in the simpler cases at the poles and equator; but requires some farther reflection and attention to trace the effects of the compound and oblique motions that occur in the intermediate latitudes. On this subject I would offer some remarks, but it would draw me beyond the limits of this letter, and I must defer it to another paper.

GEO. BUCHANAN.

14 *Duke Street, Edinburgh, May*, 1851.

BALANCED SLIDE-VALVE FOR LOCOMOTIVES.

My sketch will almost relieve me from the trouble of entering into the details of the plan which I propose for relieving the slide from external pressure, and for obtaining a fuller exhaust, more especially as its principle is analogous to the ordinary valve. The figure represents an end



elevation of a pair of cylinders, with the cover removed, and showing the pair of slides. In it will be seen that I propose to leave a space behind the slide, to contain steam equivalent to that acting on the face. The plan also comprehends the adoption of two ports—one from each of the faces of the double slide—to give more room for the exhaust action.

Lemington, Newcastle-on-Tyne. R. E.

ON STEAM-BOILER EXPLOSIONS, AND SOME NEWLY-DISCOVERED PROPERTIES OF HEAT.

VI.

The Cornish engineers, who have so greatly surpassed Watt and all other engineers, must have employed very superior means; and their practice has progressed so much before theory, that they and all others are unable to explain philosophically the means by which their wonderful achievements have been effected. This circumstance is of itself very unfortunate for mankind, as it forms a great impediment to the general introduction of the advantages they have obtained. We expect to show plainly, not only the occult cause of their success, but that far greater advantages may be obtained from that revelation, than the Cornish engineers have or can realize by their most improved practice.

That they have obtained great advantage from improved boilers with extensive surfaces, giving time for the absorption of heat from the heated smoke, which, being a non-conductor of heat, parts with its heat slowly; that they have obtained great advantages by husbanding the heat so obtained, by encasing their boilers and cylinders with substances almost impervious to heat—are circumstances of considerable account; but still, all those matters can constitute but a fraction of their great achievements, and their peculiar use of high steam in Watt's steam-jacket, (an appendage which marine engineers superciliously overlook, though its employment is both indispensable and invaluable,) will soon be found the greatest cause of the benefits the Cornish engineers have conferred on mankind.

Engineers, in general, consider that the value of a steam-jacket consists alone of protecting the cylinder from the cooling influence of the air, or loss of heat by radiation, and have superseded it by encasing the cylinders of the best engines in felt and wood; now we shall presently show this proceeding is just as irrational and unintellectual, as encasing a hungry starving animal with flannel, instead of supplying it with food.

For, first, it may be seen, by referring to our diagram No. 1, how sensibly expansible (and therefore sensibly condensible) is steam by a minute addition of heat, just at the period the water assumes the elastic form, and therefore how greatly will the initial volume of steam be then affected by a minute addition or subtraction of heat. This being premised, it will become evident that a steam-jacket is not only required to confine heat to the cylinder, but to continually furnish a supply of heat to the cylinder, so that the cylinder may in its turn furnish a continual supply of heat to the steam while it is expanding within the cylinder, and thus greatly increase both its volume and tension at little cost, which we have already shown it to do by the small quantity of heat required for the conversion of steam to stame.

The main attempt of the Cornish engineers has been directed to obtain a greater duty by the employment of denser or hotter steam than Watt employed, and in order (as they thought) to derive greater mechanical expansion, and there is little doubt they still congratulate themselves in having by that (inadequate) means alone so greatly succeeded; but the secret of the matter is, they have at the same time derived another and greater benefit from the chemical expansion or conversion of steam to stame, and having thus realized more than a double advantage, they may, might, and ought, to have suspected this occult cause of their success.

That great philosopher, Boyle, justly observed long ago, that if persons would disclose failures as well as successes, science would progress far more rapidly. Following his advice, we will detail an error that will show both the need and value of a steam-jacket, more than any argument we can employ.

A horizontal high pressure steam-engine, having a cylinder 12 inches diameter, five feet stroke, the steam employed unexpansively, was altered (with the sole view of saving fuel) to an expansive engine, by exchanging the cylinder for one of more than 20 inches diameter, and therefore of threefold capacity. The workmanship was perfect, but the profit very small.

We lately examined this engine (which is kept in constant work) by cementing some one-sided wood cups to different parts of side of cylinder, and having filled these cups with fusible metal, which being in contact with side of cylinder, served to heat different thermometers to the same temperature as the different parts of cylinder to which the fusible metal was applied.

When the engine was using steam of 75 lbs. per inch above atmospheric pressure, and therefore = to 90 lbs. per inch, and temperature above 320°, while the steam was cut off at from $\frac{1}{4}$ to $\frac{1}{5}$ stroke, the temperature of the ends of cylinder (which were alternately supplied with steam of 320° every third second of time) was found to be only 252°, and the temperature of middle part of sides of cylinder was found to be only 212°; we also found on opening a cock, inserted into head of cylinder, that the air rushed into that end of cylinder, while it was filled with the expanding steam therein, and at or before half the stroke of the engine had been accomplished.

When it is considered that the density of the initial steam was such that the expanded steam ought to have had a greater tension than the atmosphere, and a greater temperature than 212° at termination of stroke, the want and value of a steam-jacket to this engine must be apparent to the dullest capacity, and yet no marine engine we have yet seen is furnished with such an appendage.

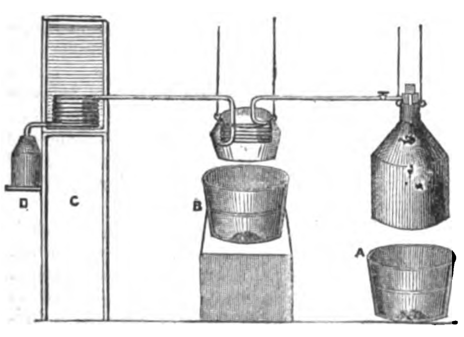
Now that we have shown why the Cornish engines are so vastly superior to all marine and manufacturing engines, we will next show how those latter engines may be caused as greatly to surpass the Cornish, which being high pressure, and very high pressure engines would be too dangerous for navigation, but more especially (be it particularly observed) that by the use of low steam converted to stame, both the greatest safety

and greatest profit must be found connected; because the reasonable heating of either low or high steam (for conversion into the more profitable stame) must terminate at the same degree,—it follows then that double profit will accrue from converting low steam to stame, because high steam of itself has been already so heated as to be incapable of more than half the profit to be derived from heating low steam.

Having shown whence the Cornish engines have derived their vast superiority, that has so astonished the most eminent engineers by the treble or quadruple duty, and which has appeared, as Mr. Palmer stated, both incredible, impossible, and incomprehensible; and having as plainly shown that by heating steam apart from water, steam having but little capacity for heat, is greatly expanded by a very inconsiderable additional quantity of heat, becomes a distinct and chemical compound of heat and water, "stame;" having shown that by its production from low steam, it must become far more profitable than from high steam; having also shown, that from no other source can the present superior duty of the Cornish engines be derived, we shall take leave of this part of our subject by stating, that we have realized a duty of more than eighty millions from the use of stame in the condensing engine, as already described, whose cylinder was only six inches diameter, unprovided with any steam-jacket or other apparatus for expanding steam, by which means the duty would at least have been doubled, and in what a Cornish engineer would consider but a toy; which nevertheless shows the present general use of fuel for the production of motive force to be so inefficient, extravagant, and wasteful, as to be discreditable to the age.

Having seen the thermometrical degrees at which steam, apart from water, is expanded by heat into larger volumes, it becomes important to learn the actual quantity of heat required for each degree of expansion; and the apparatus represented by the following diagram will show, first, how small is the quantity of heat required for doubling a volume of steam apart from water, when compared with the quantity of heat required for forming a second volume of steam of same tension—and, secondly, shows that heat in combining with steam is subject to, and controlled by, peculiar laws, perfectly distinct from those which obtain when heat combines with water for the formation of steam, which requires equal increments of heat for equal increments of volume; while, on the contrary, when steam apart from water is expanded by heat, it is not only doubled in volume by a comparative trivial quantity of heat, but every additional increase of volume is obtained by a still smaller and rapidly decreasing increment of heat, so that the greater the increase of volume the smaller will be the quantity of heat required for that latest volume; and although this is so contrary to the general laws of heat, and therefore so adverse to common apprehension, the diagram and table will not only show it to be a chemical fact, but will furnish the easy means for any competent person to verify the fact, which must be acknowledged to be of the first importance, for, were these facts understood, the present cost and weight of apparatus, and of fuel for the production of motive force, would both appear so extravagant, unscientific, and wasteful, as was the use of steam for motive force before the days of Watt; yet, at that period, as at present, engineers conceited they fully understood the subject, "*oft attempted—never reached.*"

Though it requires four times the force for double speed, it is evident, were the present enormous rate of fuel consumed in steamers judiciously applied, it would furnish abundant power for propelling them at much more than double speed, while the consumption of fuel for the voyage would, of course, be reduced to much less than one half.



A, Furnace and steam boiler suspended over it. B, Furnace and suspended steam heater for containing fluids, boiling at stationary temperatures; and hollow worm, connected by a pipe and stop-cock with steam boiler, A, and by a pipe with worm in C. C, A covered wood cistern, containing half a cubic foot of cold water, and hollow worm therein.

When a volume of steam from A was passed through the hollow worm in heater, B (filled with water boiling at 212°), and into the hollow worm in C, until the condensed water therefrom exactly filled a glass measure, containing nearly twenty ounces water, the heat separated from that definite volume of atmospheric steam, heated the water in C 38°. When similar volumes of steam from A were passed through the worm in heater B, while the contained fluid was heated to the more elevated temperature in table, the excess of heat in each case above 38° showed the decreasing quantities of heat required for increasing the original volume of steam to the magnitude stated in table.

Temperature of boiler A.	Temperature of heater B.	Volumes of steam and stame produced at those heats shown in former experiments.	Temperature of water acquired in C, showing the different quantity of heat in different volumes of equal tension.	Comparative quantity of heat required for equal volumes of steam of equal tension.	The quantities of heat in 4, 5, 6, 7, 8 volumes being fractional, were incapable of exact definition, the 5 volumes requiring but 3.38, the quantity required for 1 volume steam.
212°	212°	1	38°	38°	
212°	216°	2	42°	76°	
212°	228°	3	43°	114°	
212°	550°	8	46°	304°	

This increasing force obtained from decreasing quantities of heat applied to steam apart from water, not only proves the prodigious economy of this means of obtaining motive force, but points out the physical cause of the superlative explosive force, attendant on greatly and suddenly heated elastic fluids.

Many other and valuable advantages incidentally occurred during our experiments, which are omitted, because enough is given to stimulate the most torpid. We will, therefore, only add—

The following advantages have been frequently verified by several of the most eminent engineers and learned and competent men of New York and other places, by a condensing engine and apparatus so constructed, when actuated alternately by common steam, and by moderately heated steam, and so that the comparative quantities of heat and of water actually employed for motive force in each separate experiment, could be accurately measured, as well as the power exerted by the engine.

The general results showed that more than six times the motive force was realized from equal quantities of heat and of water, when employed to actuate the engine with heated steam or stame, than was obtained from the use of natural steam—each being alike produced from the same constant fire and time, and same engine, which engine, apparatus, scientific instruments described in this work, and testimonials of competent and respectable engineers, are open for inspection, in Fulton Avenue, near Gold Street, Brooklyn.

JAMES FROST.

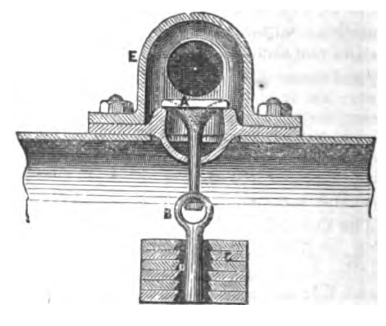
"ADDITIONAL" SAFETY-VALVE FOR BOILERS.

I shall be glad if you think the annexed sketch of what I term an "Additional" Safety-Valve, suitable for use in your pages. This valve, which, you will observe, I construct on the plan of my anti-friction curve, is for use in addition to the ordinary lever-valve, and is fixed out of the reach of the engineer, its office being to prevent explosions—

First, From the occurrence of a higher pressure than that at which the boiler is intended to work; and

Second, From shortness of water allowing the flue to become bare.

The sketch is a section of the valve-chest and seat, the valve itself being in elevation. A, Is the valve, having a bolt, B, hung to its lower tapered end, and carrying a set of weight rings, C. Round the bolt, and inside the set of rings, is cast a cylinder of fusible metal, D, of such a nature that it will give way to the weight when the temperature of the steam gets too high, allowing one ring to drop off after another. The valve is covered by the case, E, to prevent tampering; and the passage, F, carries off the escaping steam to the waste-pipe.



This description will enable the reader to see that whenever the internal steam temperature of the boiler rises too high, the valve will be gradually released from its dead weight suspended below. This escape will obviously be provided, whether the heat arises from the ordinary safety-valve failing to open, or from the flue-plates getting hot.

RAILWAY SIGNALS.

The necessity of railway passengers being able, under certain circumstances, to communicate with the guard of the train, has frequently been shown; but the railway companies have not adopted any plan (so far as I am aware) for obtaining so desirable an end, probably from no plan having been submitted to them sufficiently simple and easy of adoption. If you think the following suggestion would be of any use, you would oblige by giving it publicity. I propose that an upright tube should be fixed to one end of every carriage, in which tube should be placed a bar capable of sliding up and down. To this a line should be attached, and carried along the inside of the carriage roof, which, when drawn in, should raise the bar out of the tube; and the guard should be instructed, whenever the bar is raised, to stop the train, and ascertain what is required. At night, a small lamp might be placed on the top of the bar, which might be rendered invisible when not raised, by a shield being fixed on the top of the tube.

No. 7.

London, May, 1851.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

MARCH 4, 1851.

The paper read was "A Description of a Turn-table, 42 feet in diameter, in use on the Bristol and Exeter Railway," by Mr. I. J. Macdonnell, M. Inst. C.E.

It was stated that this table worked on a ball-pivot, and consisted of two central cast-iron arms or brackets, which carried at their extremities hollow wrought-iron transverse girders for supporting the longitudinal timber beams, forming a framing on which were placed the rails—the outer ends being supported by other girders attached to the traversing wheels, which were 3 feet in diameter. It afforded a perfect and equal bearing throughout its entire length, not being depressed more than half an inch when the leading wheels of the engine struck the table, and an engine and tender, together weighing 40 tons, were turned by the driver and stoker in three minutes. Tables on this principle had been erected both at Bristol and Exeter, and the cost, with the foundation, did not exceed £400 each.

After the meeting, Mr. Penrose exhibited the spiral instruments recently invented and registered by him, called Penrose's "Screw Helicograph, or Logarithmic Spiral Compass," and Penrose and Bennett's "Sliding Helicograph."

In the latter instrument, with which volutes and other forms of the logarithmic spiral were drawn, a frame sliding upon a smooth bar was supported by a wheel, the axis of which being set at any given angle to the bar, produced by its obliquity the converging motion in a spiral arc.

The "screw helicograph," used for drawing a more limited series of these curves, received its spiral action from a nut fixed in the centre of a revolving disc, which communicated motion to a screw; carbonic paper being used for obtaining an impression of the path of the disc.

MARCH 11, 1851.

The paper read was "A Description of the Mode of Working an Inclined Plane, of 1 in 27½, on the Oldham Branch of the Lancashire and Yorkshire Railway," by Captain J. M. Laws, R.N., Assoc. Inst. C. E.

The mode of working this incline was by a combination of locomotive power and gravity. It was at first proposed to be worked by a horizontal wheel, rope, and pulleys, with a locomotive engine and train at each end of the rope, so that one train might descend while another ascended the incline, but as this method appeared to be liable to many contingencies, by which the regular traffic would have been deranged, and the expense of locomotive power increased, a balance-weight was substituted for the descending locomotive, one line of rails being appropriated to it, and the other retained for the goods and passenger traffic. The balance-weight consisted of a heavy break van, and a number of ballast waggons filled with sand; but in place of the latter, loaded coal waggons were frequently used, as there was a coal-pit at the top of the incline, and this was found to be a most economical and advantageous way of working the coal traffic. When the bill was in parliament, it was stated in evidence, that there would be great danger in descending so steep an inclination; but the experience of seven years—during which period the rope had broken several times, and the break van had once been allowed to run down by itself, without doing any serious injury—had proved this opinion to be erroneous. The ordinary passenger trains ascended and descended the incline at from 20 miles to 25 miles per hour, the mode being to stop at the foot of the incline to attach the rope, then back the engine so as to draw the balance train off the scotch at the top, when the steam was put on, and the train ascended. This mode of working had been attended with the most perfect success, and it was thought, that if more attention was paid in the construction of railways, to what could be accomplished by gravity and impetus, in combination with locomotive power, a great saving in the original cost of the line would be the result.

The wire ropes which had been used were manufactured by Messrs. R. S. Newall & Co.; each rope was rather more than one mile and a quarter in length, 3½ inches in circumference, weighing 126 cwt., and costing £316. Their average duration was about two years and four months.

MARCH 18, 1851.

The paper read was "An Account of the Sea Walls at Penmaen Mawr, on the line of the Chester and Holyhead Railway," by Mr. H. Swinburne.

These walls were described as extending over a length of one mile and a quarter, sustaining a terrace beneath the steep slope of Penmaen Mawr, through the rocky headland of which the railway was carried by means of a tunnel, about one-eighth of a mile in length. This terrace was partly cut out of the cliff on the east side of the headland, and on the west side, for a distance of 550 yards, it was wholly formed of embankment, beyond which there was a cutting about 110 yards in length, followed by 220 yards of terrace; then another cutting about 350 yards in length, succeeded by an embankment retained on the seaward side by a wall, about 260 yards of which was within the reach of high tides. The original design for these walls consisted of a plain retaining wall, nearly triangular in section, 3 feet thick at the formation level, with a straight face battering 3 inches per foot—the back being vertical. The parapet was to have been formed of a small breast wall 3 feet higher than the level of the rails, and 2 feet thick. The masonry was specified to be "coursed walling," squared with the pick; and the face to consist of one header and two stretchers alternately.

The works were commenced in the autumn of 1845, but after two months' experience on the coast, it was thought advisable to deviate from the original design of a straight face to the wall, and to substitute an arc of a circle of 60 feet radius, with a slightly overhanging parapet; and to prevent the great increase of masonry which would have resulted from this alteration, the back of the wall was also curved. This was afterwards found to be impracticable, and the section was therefore materially altered. The nature of the materials not admitting of the "coursed walling" being executed with facility, it was determined to introduce an ashlar facing of limestone, procured from the north coast of Anglesea, and set in cement for a depth of eighteen inches from the face. The main sea wall, immediately to the westward of the headland, was now commenced, and as the embankment behind it was dependent on the completion of the tunnel, and the wall was unavoidably built in many detached lengths, it was necessary to increase the width of the base, by reducing the batter of the back of the wall. This wall had advanced very briskly during the summer of 1846, and was within 9 feet of the level of the rails, with all the lengths joined, excepting the two openings through which the materials were carried from the beach, when, on the 22d of October, the coast was visited by a severe gale, with a 17 feet tide, which completely destroyed the central portion of the wall between the two openings, besides damaging the other portions, and sweeping away the beach in front of the centre of the wall. In consequence of this lowering of the beach, it was decided to substitute for the central portion of the wall an open viaduct, consisting of 13 openings, each 36 feet in clear width, and spanned by 10 cast-iron girders, two for each rail, resting on solid ashlar piers, 32 feet in length, 6 feet thick under the impost, and 6 feet 8 inches thick at the footings, with semicircular ends next the sea. The remaining portions of the wall were completed with the limestone ashlar facing, taken from the destroyed length of wall, set in cement, and in many cases backed with brickwork also set in cement; they were also built more upright, and nearly straight on the face. In order to preserve the foundations of those parts of the wall which remained uninjured by the storm, it was resolved to form a breakwater and terrace in front, by driving a zigzag row of piles, in bays at right angles to each other, and to back these piles with planks, behind which an artificial beach was formed.

The parapet of the first length of wall, immediately to the eastward of the headland, was built for a length of 130 yards, from 8 to 11 feet higher than the level of the rails, for carrying one end of a slanting roof, or "lean-to," formed of whole timbers set close together, as a protection against stones and debris falling from the face of the cliff.

In spite of the great difficulties encountered during the progress of these walls, arising from the peculiar locality, and from the violent action of the sea, the viaduct last constructed proved perfectly satisfactory; it was, however, shown that in point of expense it would probably have been as cheap to have pierced a longer tunnel, and had a less extent of sea wall, as the contingent expenses incurred in contending with the waves were very great, and were of a nature scarcely to be foreseen and provided for by engineers.

SOCIETY OF ARTS.

"On the Different Methods of Bleaching Flax, Cotton, Linen, Calico, and other Fibres and Fabrics."—(Concluded from page 46)

The cotton trade requires no stimulus to increase its extent or value; but it is otherwise with flax, the cultivation and manufacture of which has been so much neglected in this country, that we are depending to a great extent on foreigners for the supply of that seed without which all cultivation is at an end. When we reflect on the depressed condition of our farmers, and that in Ireland only 70,000 acres are employed for the growth of flax, whilst, to free us from all importation, there ought to be 500,000 acres under cultivation; and when we find the linen trade is so rapidly increasing, that in 1847 60,000 tons of flax were imported, and in 1849 83,000 tons, showing an increase of 23,000 tons,—I do not understand why we should not distribute the vast sum that 83,000 tons of flax must represent amongst our labourers, instead of allowing it to be drained out of this country. The more so, when we know that Ireland is capable of producing, not only all the flax now imported, but also enough to supply foreign markets.

To arrive at this national result, all that she requires is a little help; and in support of this, I find from a statement made by the late Sir Robert Peel, that her cambric sold, as compared with French, was in 1800, 100 to 1000; in 1840, 4000 to 1000; and in 1847, 16,000 to 1000. If Ireland has been able to achieve such

results, she decidedly deserves great encouragement. All who have read the interesting annual report of the proceedings of the Royal Society for the Promotion of the Growth of Flax, of Belfast, must be convinced of it, and also that the Secretary, Mr. Macadam, deserves the highest praise for the energy, perseverance, and talent which he has displayed, and which has so widely contributed to the rapid progress of the linen trade.

Three acres of land, realizing a crop worth £75, are capable of giving employment to 216 spinners, weavers, and needlewomen, whose labour, although being equal to £2,217, leaves a profit of £332 to their employer, by having manufactured 1050 pocket-handkerchiefs at £2 10s. per dozen.

158	Spinners, 12 months, or 52 weeks, at 3s. 4d. per week,.............	£1360	6	8
18	Weavers, 12 months, at £24 per annum,..............................	432	0	0
40	Needlewomen, 52 weeks, at 4s. per week,............................	416	0	0
216	Persons employed. Amount of wages,...............	£2217	6	8
	Cost of Flax,.......................	75	0	0
	Total Expenses,.........	£2292	6	8
	Value of 1050 dozen of pocket-handkerchiefs at £2 10s per dozen,...	2625	0	0
	Profit,......................	£332	13	4

No one, from these figures, can help coming to the conclusion, that the cultivation and manufacture of flax must be a great source of employment and of profit to the farmer and manufacturer who will give attention to it.

Lastly, by the use of Mr. Schenck's steeping process, not only is all the seed saved, but, for a long, unwholesome, and difficult operation, we have one safe, healthy, and economical; for Schenck's rapid process prevents the production of the large amount of noxious gases (wide source of disease), besides the risk of losing an entire crop, as is often the case when the farmer is obliged to steep his flax—a few hours being sufficient to destroy the fibre, and thus to deprive him of all return. Let us consider the variety of fabrics into which flax can be woven—from the lady's cambric to the mechanic's fustian (which has of late been successfully manufactured in Ireland), the durability and beauty of its products, and, in fact, the much greater beauty of colours printed or dyed on linen, than when fixed on calico, which would always have that gloss which is artificially obtained on cotton by starch and pressure, only to be destroyed by the first washing.

I trust that the slight improvements I have made in the bleaching of linen will be still further carried out, nay, brought to perfection; thus rendering available to Ireland and Scotland their thousands of barren acres, and, by enabling them to bleach in summer as well as in winter, allow the manufacturers to renew their capital more rapidly.

Mr. Mechi on "Agriculture."—(See page 287, *ante.*)

Drainage.—Little need now be said on this point, as it is generally considered indispensable, as an agricultural basis, on all wet lands.

Steam-Engines.—If we are to house-feed much stock with cut or ground food, steam-power is indispensable. If I stop mine at any time for repairs, I find I am involved in a daily expense of nearly 20s. No doubt they will be used to force water and liquid manure for irrigating the soil, as is done advantageously by Mr. Kennedy of Myremill, Ayrshire.*

The Construction of Farm Buildings.—Had I to re-erect my farmery, I could materially improve the economy of its arrangement. The waste steam from my steam-engine, after passing under and boiling the necessary number of iron-tubs or cooking-coppers, should, in iron pipes, warm all the feeding-houses, keeping their temperature at a profitable heat for cheap fattening.

In the passages, which should be rectangular, with a turn-table in the centre, I would place a light cheap iron tramway, on which the feeding-carriage would work with facility, having on it the baskets of turnips or other food. This would economise much labour, and the feeder would no longer be in the position of the man who had to pick up a hundred eggs, at intervals of a yard, having each time to return and multiply his labour.

Feeding on Open Boarded Floors.—Perhaps this is one of the most interesting questions of the present day. Experience will teach us that, in order to succeed in farming, we must produce a much larger quantity of meat on our farms than at present, and at less cost. In order to do this advantageously, it becomes necessary to consume a large portion of the straw of the farm, cut into chaff, and cook it with meal or ground oil-cake. We are thus deprived of the usual cattle-bedding, and must find a substitute.

Having practised the system rather extensively, I will communicate to you the details, observing that I have found the balance of benefit sufficiently considerable to induce me to continue and extend it. The quantity of stock I now have on boards is—

100 lambs	60 calves	50 cows
50 sheep	40 bullocks	200 pigs.

We are indebted to the worthy and Rev. A. Huxtable for the idea; but I found his space of three quarters of an inch between the planks insufficient. I therefore measured the hoofs of the various animals, and arranged my openings accordingly. Thus,—

	Inches thick.	Inches wide.	Inches space.
For bullocks	3	4	$1\frac{7}{8}$
" sheep	$1\frac{1}{3}$	3	$1\frac{1}{4}$
" pigs	$1\frac{1}{2}$	3	$1\frac{1}{4}$
" small pigs and lambs ...	$1\frac{1}{2}$	3	1
" calves	2	3	$1\frac{5}{8}$

* See page 94, *Practical Mechanic's Journal* for June, 1850.

On heavy lands, the area allowed for each animal and its feeding apparatus is:—

	Superficial feet.
Small sheep	8
Large ditto	10
Small bullocks	30 to 40
Large ditto	50 to 60
Small pigs	6 to 8
Large ditto	9 to 11

But very much depends on the season and weather. In cold weather, pigs and bullocks can scarcely be packed too close, so long as there is room for them to lie down comfortably. Sheep require a little more room or ventilation. In fact, it requires a nice observation to adjust the ventilation and temperature. This is best done by a thermometer, because our own feelings are not always a sufficient criterion. Every cattle-shed should feel as comfortably warm as a drawing-room; for cold, stopping the circulation in the skin, drives the blood to the internal organs, and causes inflammation. The opening for ventilation should be at the highest point.

Fine bred pigs, having little hair, must have a much warmer temperature than sheep. When pigs huddle together, it is a sure sign that they are not warm enough.

I have often been struck on seeing how soon my groom will get a horse into condition by warmth, cleanliness, and food. My bullocks are all groomed daily by a boy, whose sole occupation it is. The cost is about one farthing per head per week, and I am sure it pays. Before I leave the open boards, I should say that the planks may be either of straight yellow deals, or of straight-grained hard woods. The latter are to be preferred for heavy animals, as they wear off the edges of the deals. The depth of the pits may be from two to four feet. It is necessary, once in a way, to level the manure, to prevent its touching the boards; it would soften them, and cause them to break. We never sweep the floor; but the animals are perfectly clean. The manure is taken at once from under the boards to the field, without the interventional expense of a double carting, shooting, or turning over of a dungheap. The effect on the crops is unmistakable.

The cost of erecting covered homestalls, complete with boarded floors, will not exceed 1s. to 1s. 3d. per superficial foot: and in order to pay you 10 per cent. on your investment for the building complete, you would charge your bullocks $1\frac{1}{2}$d. per week; sheep and pigs, one farthing per week.

One man on my farm feeds and entirely attends to 250 pigs. It would require two men on the old straw-bed system. Our pigs are never crammed now. Formerly, they used to be; owing to the manure heating under them, and the cold air giving those parts rheumatism. One stout lad, at 3s. 6d. per week, will feed and attend to 30 bullocks; another attends to 60 growing calves.

There is a very powerful development of the muscles on boards; so much so, that with fattening pigs not bred on the boards, I have found some of them get capped hocks. It is surprising how quickly you may fatten *young* pigs on these floors. They find it inconvenient to run about, so divide their time between eating and sleeping,—a most agreeable operation for the account-book. I think the time is coming when farmers will consider the question of how much meat a ton of turnips or hay will make under various circumstances. If so, the turning-out system will be given up. My old-fashioned bailiff admits that, on the turning-out system, two-thirds of my farm would be required to feed my animals. Now they make shift with one-third. If you desire a good appetite in your animals, turn them out for exercise in the cold. I tried the turning-out system with some calves. On asking the boy how they got on, he replied, "Oh, sir, they get on properly well now; they come in *so hungry*." An answer which settled the question in my mind.

The animals are perfectly healthy on these boards. Considering the confinement and heat, this rather surprises me, especially with the pigs, fed entirely on meal; for the ammonia, or effluvia from under them, certainly is powerful enough to discolour the paint. The great difficulty I find is, in getting a proper fixer for the ammonia; to waste which is an act of agricultural insanity. I have used sulphuric acid, ashes, and various matters, with a certain effect. I *hope* the Irish peat-charcoal will not be too dear. I have a ton coming on trial. After all, I am inclined to think common salt or the common dried clay are the best and cheapest fixers; and I have used a great deal. I can buy the salt here for 30s. a ton, and when mixed with the manure, it gives us muriate of ammonia and carbonate of soda—most valuable salts. I am also about to try Mr. Lawes's dissolved coprolites.

Another question connected with the boarded system is the fly question. Where you have plenty of food, warmth, and stock, you will have abundance of flies. My bullocks could never lie down in the daytime, owing to their attacks; and, of course, the continued lifting of their feet prevented fattening. By darkening the feeding-houses, I entirely removed this nuisance, and had the gratification of putting my animals in a most profitable state of repose; for if you have ten millions of flies, not one will bite in the dark. I find that some of my friends have long practised this system with their horses. It is essential to the successful house-feeding of bullocks with green crops during summer.

To those who are not prepared to go with me in boarded floors, I would say, by all means, then, have covered homesteads, such as may be seen at the Rev. Mr. Cooke's, of Semer, near Hadleigh, Suffolk; and at Mr. James Beadel's, Broomfield Lodge, near Chelmsford, Essex; and I am quite sure a visit to them will bring home conviction to the most resolute defender of the old and unprofitable open yards.

It is his great quantity of stock that enables the Lothian farmer to compete, at so great a distance, with the south-country farmer; and I believe it is the still greater quantity kept by Mr. M'Culloch, of Auchness, that enabled him to surpass

the Lothian farmers. Mr. Lawes has shown most indisptuably, in his admirable papers in Journals of the Royal Agricultural Society, that we can produce manure cheaper and better by feeding stock than even by purchasing guano. I mean, not feeding on turnips alone, but using the productions of the farm in conjunction with purchased food.

Whilst searching for facts to guide me to the most profitable mode, I met with the accounts of two farms, variously managed, which confirm, by comparison, my own impression, that on the quantity and management of our live stock depends much of our success in farming.

For your information, I annex a comparison of Mr. M'Culloch's Auchness farm, with a similar one in Suffolk.

An examination and comparison of the following statements afford some very striking and instructive conclusions.

The Suffolk farm—of a superior quality, employing an equal capital, but less labour, than the Auchness farm—shows a considerable loss, whilst the latter produces an ample profit. Now, neither free trade nor protection can have anything to do with this comparison. Nor are there any "peculiar advantages" to object with; because, if the Auchness farm had superior and convenient buildings for stock, the Suffolk land was naturally superior and in previous good cultivation, whilst the Auchness farm, much of it naturally poor, had to be improved at the tenant's cost. In the Suffolk farm there is no purchased manure or imported food; on the Auchness farm we have £719 so expended. On the Auchness farm the amount of meat made is £884, being the produce of ninety-one acres and the purchased food; on the Suffolk farm only £352 was received for meat, although one hundred and eleven acres were used for that purpose.

On the Auchness farm £1680 worth of corn and potatoes was sold; on the Suffolk farm only £793 was the value of the grain crops.

Here we have a clear explanation of the causes of success and failure. In one case we see the animals housed, warmed, ventilated, groomed, their food cooked, and the utmost made of it, chemically and physiologically; in the other, the usual mode of turning out, and consequent waste and misapplication of food. Here we have a dependence on the *natural* production of the soil, unaided by imported food or manure, and, consequently, a minimum production with almost a maximum expense; there, a constant addition to the productive powers of the soil, with a maximum produce, and consequent diminished per centage of expense.

ROYAL INSTITUTION, MANCHESTER.

"On Voltaic Ignition and Illumination,"* by W. E. Staite, Esq.

We have seen by the last experiment, that the different agents have all been manifested in one line of conduction.

The theory we would venture to deduce from these facts, and from concurrent testimony, is a theory which we think will, when well weighed, be found to account satisfactorily and intelligibly for almost everything at present sought to be accounted for on the theory of "latent forces," and without involving any absurdity in the use of terms, and without contradicting any scientific facts ascertained and generally received. The theory involves the proposition, that there is but one great force with which matter is endowed, and not a multiplicity of forces. That this force, acting through different media, and under different conditions and circumstances of matter, developing itself in the varied phenomena, known as the phenomena of the imponderable agents: that these agents, though apparently distinct, and acting within apparently defined limits, are in reality mutually related to each other, as parts of a whole, by links of connection so palpable and evident, as to warrant us in designating them "a fraternal group." We think, also, it would simplify our conception of these phenomena, if the term force were restricted to the primary dynamic influence itself; and instead of speaking of heat, for instance, as an expansive force, we spoke of it as an expansive agent. The same would apply with equal advantage to the others of the group; if we always spoke of them as agents, and not as forces. Keeping this theory in view, we shall proceed to consider the phenomena of voltaic ignition and illumination—phenomena resulting from chemical affinity and chemical action.

Now, if the two terminal wires of a voltaic pile be connected—one with the last negative metallic element in a compound series of pairs, and the other with the last positive metallic element in the same series, and the points be brought in contact, and then separated to a certain short distance apart—a violent disruptive action ensues, accompanied by the development of intense heat and light, especially on the positive wire, that is, the wire in connection with the last negative metallic element—heat so intense as frequently to melt the wire, and cause it to fall away in drops. If to these terminal wires we fix two pieces of well-baked charcoal or graphite, and repeat the process, the resulting phenomena are of the most brilliant and startling character. The heat is so exalted, that the most intractable metals may be easily fused by it, such as the metals platinum and iridium; and the light so intense and pure, as to rival that derived from the sun itself. (Here a number of beautiful illustrations were given.) One reason why the light derived from the incandescence of the copper is less than that from the charcoal, will be found in the different conducting powers of these two bodies—the conducting power of charcoal or carbon being, as we have ascertained by repeated experiments, only $\frac{1}{2000}$th part that of pure copper; so that the power transmitted suffers less opposition in the case of copper conductors, than when carbon is employed. And further, the molecular amorphous structure and peculiar nature of the carbon, affords mechanical facilities not possessed to the same extent by the metals for the radiation of light—such, for example, as the readiness with which, under the influence of intense heat, they separate and are minutely divided, without actually fusing, as metal does.

Again, the further apart these two pieces of carbon are separated, consistently with the maintenance of the phenomenon, the more concentrated is the heat and the more intense the light; but it will be found, if a galvanometer be included in the circuit, that in proportion as this distance between them is increased, the galvanometer will indicate a decreased and decreasing transmitted power, and that at that point of distance where the least expenditure of power is indicated, the resulting heat and light will be the greatest. When these two pieces of carbon are brought into actual contact, and kept in contact, the heat and light are vastly less, but the power transmitted and expended is at its maximum. We find, then, that when the resistance to the transmission is least, the heat and light are also at the least, and as the resistance increases, the heat and light increase also. Another proof of the effects of impeded "motion", in connection with heat and light.

These facts, with all that they involve, are so inexplicable upon the received theories which embrace the doctrine of latent forces, that we are compelled to look elsewhere for a solution of the difficulty. Now, in the voltaic pile, or electromotor, we have the metals and the electrolyte ready to develop and transmit electric power, resulting from chemical action, as soon as a line of conduction is open for such transmission; such, for instance, as when the terminal wires are brought together in a closed circuit. Until this path or line of conduction is opened, the intervening air, from its bad conducting properties, almost entirely prevents any transmission,—but not completely so, as we shall presently show,—and just in proportion as conducting power is afforded, the affinities are called into play, or rather rush into action, in obedience to their laws,—decomposition of the electrolyte ensues, with all the accompanying chemical changes, until a perfect equilibrium has been effected, by a complete satisfaction of the excited affinities, indicated, finally, by a total cessation of transmitted power. This transmitted power, which we call "electricity," is thus shown to be identical with "chemical affinity," seeing that it ceases at the same moment that chemical affinity ceases, and is active and energetic exactly in the same degree as chemical affinity is active and energetic, in all cases and under every variety of condition. Now, the line of transmission, in a closed circuit, embraces not only the metallic elements of the pile and the electrolyte, but also the conducting wires and the copper strips which unite the metals in pairs. The power is transmitted, not only through the fluids, but also through the solid metallic atoms of the wires and strips. In its transmission through the fluids, it is accompanied by all the phenomena of electrolysis; but in the case of the transmitting or conducting wires, there is no electrolytic action whatever going on in these wires, no chemical changes effected as far as we know; and yet the power transmitted is one and the same power. In the case of the wires, we undoubtedly find a polarised condition of their molecules excited, each atom of matter of which they are composed being thrown into a state of motion (vibration or undulation). May not this motion be merely a renewed action of the same "motion" which was the initial power (in a secondary sense), thus appearing in another part of the circuit? We can scarcely conclude otherwise, with regard to the fluid portion of the circuit (whose atoms move freely amongst themselves), than that a similar polarisation is induced throughout the molecules of these fluids, as in the more solid wires, and that the phenomena induced by the latter can be induced by the former, with suitable apparatus and appliances.

Again, electro-magnetism, or magnetism induced in ferruginous bodies, when placed under the influence of current power, is spoken of as an agent capable of excitation only by induction. It cannot be transmitted or transferred as electric power is, but by a series of inductions it may be and is transmitted. This magnetic power, communicated by contiguity to highly polarised atoms, is but a secondary polarisation induced by the wires, in another set of contiguous atoms. If we take a helix of copper strip, and include it in the voltaic circuit, the atoms of this helix all become polarised. If we surround this helix with an iron cylinder, we find the cylinder will become magnetic for the time being, polarised by what is called direct induction from the metal of the helix. If we add other helices, we shall find that by the same power similar phenomena are developed. Now, what is induction? What are we to understand of the *modus operandi* of this agency? How is it effected—through what media? Glass and similar bodies, which are ranked generally as perfect non-conductors, cannot impede or prevent the transmission of this inductive power. It is clear that, if a plate or tube of glass be interposed between the helix and the soft iron, that the power which has induced magnetism in the latter must have been transmitted through the glass, and yet the glass is spoken of as a perfect non-conductor. If it were so, how could the power have been transmitted through it? Are not the atoms of glass, in such cases, thrown into a peculiar state, analogous to polarisation, and thus rendered capable of transmitting the power, modified as we may suppose it to be, from its extensions, and exhibiting phenomena suitable to the peculiar affections of the media? If this be so, electro-magnetism has its lines of conduction as much as current electricity has, and may be transmitted: as, for instance, it is in this view, from the helix through surrounding air and glass, and other bad conductors, to the other metallic atoms contiguous, and so on through other media of air or glass to other helices, but with diminished effects, probably in the ratio of the resistances, and as the square of the distances.

The tangential action of magnetism, so entirely different from the other agencies of nature, is no argument against the theory advanced, but rather the reverse. Its line of power is not parallel to that of the current in the wire, nor in any plane passing through that direction. As discovered by Oërsted, and subsequently confirmed by Ampere, Arago, and by our own philosophers, Davy, Faraday, and others, it is evidently in a plane perpendicular with the wire, but still it has no tendency to move the poles of the magnet in a right or radial line, either directly towards or directly from the wires, as in every other case of attractive or repulsive agency. The peculiarity of its action is, that it produces tangential motion, in a circular direction, all round the wire; that is, in a direction at right angles to the radius.

* See *ante*, Pp. 188 and 218, Vol. III.

May not this tangential action be due to the surplus or excess of power, excited by induction in the atoms of the ferruginous body itself, over and above the power expended to establish an equilibrium between the attractive and repulsive agencies of the electric current, so called? If so, its line of action would necessarily be tangential for this purpose, or excess of power could only be exerted (as we find it to be in all cases) in the direction of a tangent to a circle described round the wire in a plane perpendicular to it, for there is no other pathway open for its transmission. We advance this hypothesis with diffidence, believing, nevertheless, in its truth; being consistent, moreover, with fact, and with sound mathematical reasoning.

Magnetism, then, seems to be an agent just as dependent upon electricity for its development, as electricity is upon chemical affinity, and chemical affinity upon motion. It would be incomprehensible to say, that the magnetism was latent in the ferruginous body, for it was not magnetic at all until its atoms were thrown into a new condition by induction and polarisation; and it was as much latent as any of the other agents could be said to be latent in other instances.

Heat is generally spoken of as expansive force, rather than as an agent merely. Heat is superior in power to the powers of attraction and cohesion, and hence heat is spoken of as antagonistic to attraction and cohesion. A drop of water at 70° Fahr. may be taken as an illustration of matter in a balanced condition. By the laws of cohesion and attraction, modified by the law of gravitation, it remains a globule of water; but, if we raise the temperature of this globule of water to 212°, the powers of attraction and cohesion give way, the drop of water is minutely divided up in vapour, and dissipated, each atom being charged with heat,—these atoms, as they part with their heat, again uniting and forming water as before. Now, the heat, in such cases, can hardly with propriety be said to have been latent in the water atoms, inasmuch as we see it was acquired from external influences, communicated by external agency.

Now, retarded motion, in any body, is always accompanied by the phenomena of heat. The forcible mechanical separation of the atoms of the globule of water, imply retarded motion. The friction of solid matter is only retarded motion, developing heat. Chemical action resulting from chemical affinity, also involves retarded motion throughout the whole line of electrolysis; and we have seen that chemical action, not forgetting friction, is intimately concerned in the phenomena of electricity and magnetism. There can be no chemical combination unattended by the development of heat, though the heat may be sometimes overcome by accompanying physical dilatation. In the heat developed in chemical combinations, each molecule of the combining body acts upon the contiguous molecule of the other, and so the heat takes place throughout the whole mass, with no definite direction. But, as Mr. Grove has observed, "by the great discovery of Volta, chemical affinity can be transferred; and a chemical combination taking place at one point, can produce a chemical decomposition at another point, a chain of material particles of indefinite extent being interposed. For example, the substance iodine may be evolved from a compound in which it previously existed, although long wires and the human body are interposed between the substances chemically combining and that undergoing decomposition. So that, as before, we have chemical action and electrolysis in the fluids, polarisation in the wires, chemical action again established in the compound from which the iodine is evolved, and so on through the remainder of the circuit or line of conduction (of which the human body forms a part), back to the battery or electro-motor.

Heat, in like manner, may be developed in any part of a line of conduction, or in several parts simultaneously; in short, wherever an impediment is offered to the free transmission of the power. For instance, wherever the voltaic conductor is most contracted, there we find the greatest heat; because there motion is most retarded. A chain composed of links of iron, alternately large and small, illustrates this very satisfactorily. The large links, transmitting the power pretty freely, remain cool; while the smaller links, impeding the free transmission, become intensely heated. Now, if the heat developed in the experiment were latent in any part of the circuit, in what part of the circuit was it latent? Has it not resulted from changes—we might almost say mechanical changes—in the state and condition of the material atoms forming the line of electrolysis and conduction—in one unbroken path, from one unintercepted series of causations, traceable through marked and striking gradations, up to its primitive source, namely, that great initial dynamic influence, of which "motion" is the chief exponent?

MONTHLY NOTES.

Copper-Faced Printing Types.—M. Petit, some time back, proposed the use of solid copper types, and at one of the Royal Society Soirees he exhibited a clever machine which manufactured them at the rate of thirty-two per minute. Just now we have before us a specimen of a Boston (U. S.) paper, *The Pictorial Drawing-Room Companion*, which the publisher states to be printed from "copper-faced type." From this description, we presume that the body of the letters is of common metal, the face being electrotyped to give it a copper printing surface. Whether this is the case or not, we must give the Boston printer great credit for the excellence of his typography. The letters are clear and sharp, contrasting most favourably with the muddy impressions of British newspapers, and compared to what we are accustomed to receive as an American newspaper, the improvement is still more striking.

The Civil Engineer, England's Master-Spirit.—Let us commence at home, and see what appearance this island of ours puts on at the peaceful *reunion* of nations. Is it Britannia, with her trident and plumed helmet, and the lion recumbent at her feet, or John Bull's portly form, carrying weight in every limb, and determination, not unmingled with prejudice, from the crown of his broad-brimmed hat to the soles of his top-boots? Far otherwise. Some traces of those popular types of our nationality may indeed be traced, but England has greatly changed. Her genius is mechanism, her master-spirit the civil engineer, her tendencies—to relieve labour from its drudgery, and delegate to iron, to steam, and to the other powers of the inanimate world, as much as possible of the burden of toil. If you doubt this, go and look at the great department of machinery in the crystal palace; watch that vast collection of interesting objects, every portion of which lightens immeasurably the burden of life, and releases hundreds of hands from the most irksome forms of industry. You will there see how mechanism is extending her dominion over the whole empire of labour; how she rises in textile fabrics to the manufacture of the most delicate and intricate lace; how from wood she aspires to fashion iron into the most exact proportions; how, with steam as her handmaid, she works the printing press and navigates the ocean, and outruns the swiftest animal in her course. Turn into the agricultural implement department, and you will find everything now done by machinery. By it the farmer not only sows and reaps, but he manures and hoes. By it he thrashes out and grinds his corn, and prepares the food for his cattle. He can even drain by machinery, and it is difficult now to find a branch of his business into which it does not largely enter. In our manufactures, the mechanical genius of the country reigns supreme. Those beautiful fabrics are nearly all the evidences of its power. Soft goods and hardware are equally indebted to it, and in its presence the unaided efforts of handicraftsmen appear small and insignificant indeed. It travels everywhere, and invades every compartment, even that of the fine arts, in the court dedicated to which some of the most conspicuous contributions are specimens of printing in oil, and attempts to reproduce, by mechanical means, the sentiment and inspiration of the painter.—*Times.*

Dunin's Expanding Model of the Human Frame.—One of the most extraordinary objects to be found beneath the immense show-case in Hyde Park, is an expanding figure of a man, invented and made by Count Dunin. The history of this figure has in it the essentials of romance. Becoming involved in the Polish insurrection, he was banished from Russia early in life. He sighed for his return to home and friends; and, knowing the character of his emperor, he turned his attention to mechanical pursuits, in order to prove his value to his country, were he restored to it. In the western gallery, the curious visitor will find, in the result of his labours, a proof of his enduring perseverance. The figure represents a man five feet high, in the proportions of the Apollo Belvidere, and from that size the figure can be proportionally increased to six feet eight inches; and as it is intended to facilitate the clothing of an army, it is so constructed as to be capable of adjustment in every part to the particular proportions of each individual. To obtain this result, the most complex contrivances are required, and the number of springs, screws, and other movements, render it a marvel of human ingenuity. The tailors regard it with admiration, but its costliness of construction renders it an instrument too expensive for them to purchase. It is a marvellous sight to see the model expand, and it is well deserving a careful inspection. The mechanism is composed of 875 framing pieces, 48 grooved steel plates, 163 wheels, 202 slides, 476 metal washers, 482 spiral springs, 704 sliding plates, 497 nuts, 8,500 fixing and adjusting screws, with numerous steadying pins, so that the number of pieces is nearly 12,000.

A Frenchman's Notes of the Exhibition.—I say nothing of the English exhibition: it is truly formidable. Firm at its post, England is represented by a swarm of machines formidable even when at rest. There are printing presses striking off 7,000 copies an hour, and men are astounded beforehand at the results which must flow in the future. One novelty worthy of interest is, that all these machines, now motionless, will at a given signal all begin working. These powers are placed upon a flooring, beneath which flooring circulates the powerful spirit of these inanimate wheels, and the same breath will soon have marked out the work to be done. Quite a novel effect in my eyes is the name of each nation inscribed in the national language of the people who have hastened to join in these great jousts. Russia and Poland here cease to speak the same language! Germany and Spain have used the alphabet proper to each; and we may read in a fair Greek character the inscription of the Athenian manufacturers. Athens a place of trade! Ye Gods and Goddesses! That Athens should send her scarfs and tissues to the same spot where the imperishable marbles of the Parthenon languish beneath a cloud-veiled sky! Who had predicted this of the country of Homer and Phidias?

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Not far from the *trade* of Greece stands the *art* of Turkey. Your Turk is, indeed, an artist. He addresses himself to the eye; that which he is curious above all is splendour and richness; the useful he leaves to England, the graceful to France. He believes in embroidery, in purple, in pearls and diamonds! He would give all the coal of England for the famous Koh-i-Noor—the Mountain of Light. I have seen him, this honest Turk, seated in melancholywise within his little compartment, full of amber, musk, and carpets, his eyes half-closed, and in the attitude of resignation. Doubtless he asks himself what on earth has brought him here amid the Infidels—among Christians, Protestants, Jews, Idolaters, Renegades—the new prophets and the old prophets of each nation. To what end has he been dragged into this strife? He would measure his strength with no man! Why show him your inventions and your machinery? He wants them not; he will have nothing to do with them. He leaves us our looms, our hammers, our anvils, together with the necessities implied in all these various labours. What is steam to him? Has he not his sun, his wine, his opium, his newspaper, his dreams, his poetry, his tobacco? Alas! worthy individual, he is at the present moment deprived of the everlasting festival of his thoughts and of his life. Etiquette and custom have torn from his hands his faithful companion, his graceful dispenser of the grateful vapour, his counsellor and hospitable friend—his pipe! "*On ne fume pas ici*"—such is the law of this caravanserai of human industry; and that each nation may be advised thereof, it is written in every language, "*On ne fume pas ici,*" "No smoking allowed," "*Non e*

permesso di fumare," and so on to the end, and the poor Turk has been constrained to obey. It is God's will! It is the will of the Englishman! If the Exposition of Industry have its martyrs, this surely is one!

CAMEO-CUTTING.—In the posthumous volume of Mr. Holtzapffel's "Turning and Mechanical Manipulation," we glean the following notes on cameo-cutting:—Cameo-cutting, or the engraving of gems in relief, is effected with the same apparatus, and by the same general methods, as those employed in engraving corresponding forms in intaglio, and both arts are occasionally practised by the same individuals. The principal differences in the manipulations of the seal-engraver and the cameo-cutter, arise from the design being, in the former case, wrought concave, and in the latter convex. The tools with which the former are produced being themselves convex, they may, in most cases, be selected of counterpart curvatures to the concave details required in intaglio engraving; but the convex forms in cameo-cutting have to be produced with convex tools, which cannot therefore be selected of counterpart forms, but the convex surfaces have to be produced by twisting the stone about at all angles, beneath the rounded edge of the tool. For this reason, the engraving of gems in relief is usually considered to be more difficult than engraving in intaglio. On the other hand, however, the deep recesses in cameos are generally more accessible than those in intaglio, and the principal source of difficulty in gem-engraving is, therefore, in some measure avoided.

The stones selected for engraving in cameo are generally those called onyxes, consisting of two layers of different colours forming a strong contrast, as the black and white layers of the agate, or the red and white layers of the agate, or the red and white layers of the carnelian.

The design is almost always engraved exclusively in the white layer, and the dark-coloured layer forms the background, the contrast of the two colours serving to render the design more distinct. Sometimes onyx-stones, having three or more layers of colours, are employed for cameos: these are selected when, either from the great amount of relief desired in the engraving, the thickness of the white layer would be insufficient to allow of the entire design being engraved in it, or that it is desired to make the most prominent parts of the design of different colours, in order to improve the effect.

Mineralogists generally restrict the name onyx to a variety of chalcedony, consisting of alternate layers of brown and opaque white; but those artists who work in precious stones, usually attach a much more extended signification to the name,—and the following interesting particulars, from the pen of Mr. H. Weigall, will explain the cause of these discrepancies:—

"All the stones in different coloured layers employed for cameos, are known to practical men by the general name of onyxes; but some confusion has arisen with regard to the nomenclature of stones of this class, in consequence of the imperfect information of those authors who have undertaken to describe them. It is a remarkable fact, that no author who has undertaken to describe the onyx has given this simple, and, to all practical persons, intelligible description of it—namely, a stratified stone, occurring in any of the semi-transparent or opaque varieties: thus there is the onyx of the sard, called the sardonyx; that of the carnelian, called the carnelian onyx; and so on, through the whole variety of stones.

"The name *onyx* is derived from a Greek word which signifies *nail*; and the authors before referred to, have evidently been perplexed to make out any resemblance between such an object, and that particular variety of the onyx which they happened to describe. Thus Pliny could see no resemblance to a human nail in the specimen from which he took his description of the onyx (which appears to have been a bad sardonyx), and he therefore thought it must be a horn or hoof, and fancied a resemblance to a horse's hoof. Theophrastus seems to have described a cloudy specimen of the carnelian as the onyx, and he fancies it resembles the pink and white colours sometimes observable on the human nail."

Mr. H. Weigall, however, suggests, that there was an original propriety in the name, and that it most probably arose from the practice of the ancients in staining their nails; for if the stain were only applied at distant intervals of time, the lower portion of the nail would grow between the applications, and present a shade of white at the bottom of the coloured nail, and thus render it a fair type of the onyx-stone. Mr. Weigall has made inquiries of travellers who have visited those eastern nations where the practice of staining the nails is still continued, and has found this view to be corroborated, as they agree in stating that the nails commonly present two colours exactly resembling an onyx.

ENGLISH PATENTS.

Sealed from 24th April, to 15th May, 1851.

William Andrews, George-street, Westminster, mechanic,—"Certain improvements in steam-engines, and in boilers, in pumps, in safety-valves, and in wheels and axles."—April 24th.

William Smith, Snow-hill, London, gas-meter maker, and Thomas Phillips, Brighton, gas-fitter,—"Certain improvements in apparatus for heating, ventilating, and cooking by gas."—24th.

Robert Hawkins Nicholls, Pimlico, Middlesex, gentleman,—"Improvements in machinery for giving motion to agricultural and other machinery."—24th.

Joseph Clinton Robertson, of the firm of J. C. Robertson & Co., 166 Fleet-street, London, patent agents,—"Improvements in musical instruments."—(Communication.)—24th.

Daniel Dalton, Span-lane, West Bromwich, Stafford,—"Improvements applicable to railroads."—26th.

J. C. Haddan, Bloomsbury-square, civil engineer,—"Improvements in the permanent way of railways, in railway and other carriages, and in the manufacture of papier-maché to be used in making carriages and other articles."—26th.

James Bagster Lyall, Thurlow-square, Brompton, Middlesex, gentleman,—"An improved construction of public carriage."—26th.

Benjamin Hyam, Manchester, tailor and clothier,—"Certain improvements in the method of fastening down trousers, or other articles of wearing apparel."—26th.

Jonathan Wragg, Wednesbury, Stafford, coach and axle-tree smith,—"Certain improvements in railway and other carriages."—26th.

Robert Milligan, Harden Mills, near Bingley, York, manufacturer,—"A new mode of ornamenting certain cloth fabrics."—26th.

James Nasmyth, Patricroft, Lancaster, engineer, and Herbert Minton, Stoke-upon-Trent, Stafford, china manufacturer.—"Certain improvements in machinery or apparatus to be employed in the manufacture of tiles, bricks, and other articles from disintegrated or pulverized clay."—26th.

Benjamin William Goode, Birmingham, Richard Boland, of the same place, and James Newman, also of Birmingham,—"Improvements in chains, chain-pins, swivels, brooches, and other fastenings for wearing apparel."—29th.

Henry Lund, of the Temple, Esq.,—"Improvements in propelling."—29th.

Philip Webley, Birmingham, manufacturer,—"Improvements in the manufacture of boots and shoes, and in rendering the said manufacture waterproof, also in the machinery and materials to be used therein."—29th.

William Edward Newton, Chancery-lane, civil engineer,—"Improvements in the manufacture of woven and felted fabrics."—(Being a communication.)—May 3d.

John James Greenough, Washington, United States, America, Esq.,—"Improvements in obtaining and applying motive power."—(Being a communication.)—3d.

Gaetan Kossovitch, Middleton-square, Middlesex, gentleman,—"Improvements in rotary steam-engines."—(Being a communication.)—3d.

Edwin Rose, Manchester, Lancaster, civil engineer,—"Certain improvements in boilers for generating steam."—3d.

Charles Cowper, Southampton-buildings, Chancery-lane,—"Improvements in coverings for buildings."—(Being a communication.)—3d.

Peter Armand Lecomte de Fontainemoreau, South-street, Finsbury, Middlesex, and 24 Boulevard Poissonniere, Paris, France,—"Improvements in the manufacture of fuel."—(Being a communication.)—3d.

William Smith, Upper Grove Cottages, Holloway, Middlesex, engineer,—"Improvements in locomotives and other engines, and in carriages used on railways."—3d.

Pierre Armand Lecomte de Fontainemoreau, South-street, Finsbury, London, and 24 Boulevard Poissonniere, Paris,—"Certain improvements in electric telegraphs."—(Being a communication.)—3d.

William Cooke, 18 Gt. George-street, Westminster, Middlesex, civil engineer,—"Improvements in the manufacture of soda and the carbonate thereof."—(Being a communication.)—3d.

James Pyke, Westbourne-grove, Bayswater, Middlesex,—"Improvements in the manufacture of leather; also in the making of boots and shoes."—3d.

Alexis Delemer, Radcliffe, Lancaster, civil engineer and machinist,—"Certain improvements in the application of colouring matter to linens, cottons, silks, woollens, and other fabrics, and to linen, cotton, silk, woollen, and other weft, and also in machinery or apparatus for these purposes."—6th.

William Henry Brown, Ward's-end Steel Works, near Sheffield, York, steel-roller,—"Certain improvements in the manufacture of helves."—6th.

Thomas Robert Mellish, Regent-street, Middlesex, glass manufacturer,—"Certain improvements in instruments and apparatuses for the admission and exclusion of light and air into and from buildings and carriages, and in the manufacture of reflectors of light; parts of which improvements are also applicable to the decoration of articles of furniture."—7th.

William Edward Newton, 66 Chancery-lane, Middlesex, civil engineer,—"Improvements in apparatus for the generation and condensation of steam for various useful purposes; also improvements in certain parts of engines to be worked by steam, air, or gases."—(Being a communication.)—8th.

Harding Hallen, Burslem, Stafford, manufacturer,—"Improvements in gas-burners."—10th.

Charles Morey, United States, America, gentleman,—"Improvements in machinery for preparing, dressing, cutting, and shaping stone, and other materials made use of for building purposes and architectural decorations."—10th.

Emilian de Dunin, Queen Charlotte-row, New-road, gentleman,—"Improvements in apparatus for measuring persons, and for facilitating the fitting of garments."—4th.

Thomas Haimes and John Webster Hancock, Melbourne, Derby, manufacturers, Albert Thornton, of the same place, and James Thornton, Leicester, mechanics,—"Improvements in the manufacture of knit and knit and looped fabrics, and for raising pile thereon."—10th.

Edward Wilkins, 60 Queen's-row, Walworth, Surrey, gentleman,—"Improvements in labels or tickets."—13th.

Edward John Carpenter, Toft Manks, Norfolk, Esq., captain of her Majesty's navy,—"Improvements in the construction of ships and vessels, and in machinery or apparatus for propelling and directing the same."—13th.

Luke Smith, Littleborough, Lancaster, mechanic, Mark Smith, Sun Iron-works, Heywood, in the same county, power-loom maker, and Matthew Smith, Over-Darwen, in the same county,—"Improvements in fabrics, in weaving, and in machinery and apparatus for winding, weaving, cutting, and printing."—14th.

William Hemsley, Melbourne, Derby, lace manufacturer,—"Improvements in the manufacture of looped fabrics."—15th.

Robert Oxland and John Oxland, both of Plymouth, chemists,—"Improvements in the manufacture and refining of sugar."—15th.

SCOTCH PATENTS.

Sealed from 24th March, to 12th May, 1851.

David Davies, Wigmore-street, Cavendish-square, Middlesex, coach-maker,—"Certain improvements in the construction of wheel carriages, and in appendages thereto."—March 24th.

Charles Zavier Thomas (de Colmar), Chevalier de la Legion d'honneur of Paris, France,—"An improved calculating machine, which he calls Arithmometer."—25th.

William Milner, Liverpool, Lancaster, patent safe and safety-box manufacturer,—"Certain improvements in safes, boxes, and other depositories, for the protection of papers or other materials from fire."—26th.

John Stephens, of the Albynes, Astley-Abbotts, Salop, gentleman,—"Certain improvements in thrashing machinery."—28th.

James Cheetham, jun., Chadderton, near Oldham, Lancaster, manufacturer,—"Certain improvements in the manufacture of bleached, coloured, or party-coloured threads or yarns."—April 2d.

James Black, Edinburgh, machine maker,—"A machine for folding."—(Partly communication.)—3d.

William Boggett, St. Martin's-lane, Middlesex, gentleman, and William Smith, Margaret-street, in the said county, engineer,—"Improvements in producing and applying heat in lighting, and in engines to be worked by steam or other elastic fluid, which engines are also applicable to pumps."—3d.

Henry Duncan Preston Cunningham, Bury, Hants, paymaster in the royal navy,—"Improvements in reefing sails."—4th.

James Hamilton Browne, Reform Club, Pall Mall, Middlesex, Esq.,—"Improvements in the separation and disinfection of fecal matters, in the purification of gas, in the preservation of animal matters, and in the apparatus employed therein."—9th.

Thomas Greaves Barlow, 32 Bucklersbury, London, civil and consulting gas engineer, and Samuel Gore, Park-road, Old Kent-road, Surrey, engineer,—"Improvements in the treatment of certain substances used in the production of gas, for giving light and heat, and of some of the products of the said substances, as also in the apparatus employed in the manufacture of such gas, and in discharging and giving motion to gas."—9th.

William Galloway, and John Galloway, Manchester, Lancaster, engineers,—"Improvements in steam-engines and boilers."—14th.

Samuel Holt, Chester, manager,—"Certain improvements in the manufacture of textile fabrics."—14th.

John James Greenough, Washington, United States of America, Esq.,—"Improvements in obtaining and applying motive power."—(Communication.)—14th.

David Christie, 3 St. John's-place, Broughton, Salford, Lancaster, merchant,—"Improvements in machinery or apparatus for preparing, cording, spinning, doubling, twisting, weaving, and knitting cotton, wool, and other fibrous substances; also for sewing and packing."—(Communication.)—14th.

Benjamin Guy Babington, M.D., Hanover-square, Middlesex,—"Improvements in preventing incrustation in steam and other boilers."—16th.

Henry Bessemer, Baxter House, Old St. Pancras-road, Middlesex, engineer,—"Improvements in the manufacture and refining of sugar, and in machinery or apparatus used in producing a vacuum in such manufactures, and which last improvements are applicable for exhausting and forcing fluids."—17th.

Thomas Hill, Langside Cottage, near Glasgow, Renfrew, Scotland, Esq.,—"Certain improvements in wrought-iron or malleable-iron railway chairs, and in the machinery or apparatus employed for producing the same."—(Communication.)—17th.

Thomas Haimes and John Webster Hancock, Milbourne, Derby, manufacturers, and Albert Thornton, Leicester, mechanic,—"Improvements in the manufacture of knit and looped fabrics, and for raising pile thereon."—28th.

Gaetan Kossovitch, Middleton-square, Middlesex, gentleman,—"Improvements in rotatory steam-engines."—29th.

John Boland, Norfolk-street, Strand, Middlesex, engineer,—"Certain improvements in weaving machinery."—30th.

Edmond Morewood, Enfield, Middlesex, gentleman, and George Rogers, of the same place, gentleman,—"Improvements in the manufacture of metals, and in coating or covering metals."—30th.

Hugh Barclay, Regent-street, Middlesex,—"Improvements in the means of extricating or separating fatty and oily matters, in refining and bleaching fatty matters and oils, animal and vegetable, wax and resins, and in the manufacture of candles and soap."—30th.

Thomas Beale Browne, Hampton, near Andoversford, Gloucester, gentleman,—"Improvements in weaving and preparing fibrous materials, and staining or printing fabrics."—(Communication.)—May 1st.

Samuel Jacobs, Highgate, Kendal, Westmoreland, cabinet-maker,—"Certain improvements in printing on woollen, cotton, paper, and other substances, parts of which improvements are applicable also to the purposes of colouring, shading, tinting, or varnishing such substances."—2d.

Charles Iles, Bordesley Works, Birmingham, Warwick, machinist,—"Improvements in manufacturing picture-frames, inkstands, and other articles in dies or moulds, also in producing ornamental surfaces."—5th.

John Alexander Lerow, Boston, United States of America, gentleman,—"Certain improvements in sewing machines."—9th.

François Marcellin Aristide Dumont, Paris, France, engineer,—"Improved means and electric apparatus for transmitting intelligence."—9th.

Henry Wimshurst, Limehouse, Middlesex, shipbuilder,—"Improvements in steam-engines, in propelling, and in the construction of ships and vessels."—12th.

Henry W. Adams, Boston, Suffolk, and Massachusetts, North America,—"An improved means of generating galvanic electricity, of decomposing water or various electrolytes, of collecting hydrogen, of burning it or atmospheric air separately or in combination."—14th.

IRISH PATENTS

Sealed from 20th March, to 19th May, 1851.

William Hodgson Gratrix, Salford, Lancaster, engineer,—"Improvements in the method of producing or manufacturing velvets, or other piled fabrics."—March 20th.

William Stones, Queenhithe, London, stationer,—"Improvements in the manufacture of safety paper, for bankers' cheques, bills of exchange, and other like purposes."—25th.

John Ransom St. John, New York, America, engineer,—"Improvements in the process of, and apparatus for manufacturing soap."—28th.

Frederick Watson, Moss-lane, Hulme, Manchester, gentleman,—"Improvements in sails, riggings, and ships' fittings, and machinery and apparatus employed therein."—28th.

Herbert Taylor, 46 Cross-street, Finsbury, Middlesex, merchant,—"Certain improvements in the manufacture of carbonates and oxides of barytes and strontia, sulphur or sulphuric acid, from the sulphates of barytes or strontia, and for consequent improvements in the manufacture of carbonate and oxides of soda and potassa."—April 2d.

George Shepherd, Holborn Bars, London, civil engineer, and Charles Button, of the same place, operative chemists,—"Certain improvements in the means or appliances used in conveying telegraphic intelligence between different places."—15th.

Gaetan Kossovitch, Middleton-square, Middlesex, gentleman,—"Improvements in rotatory steam-engines."—(Communication.)—2d.

Henry Crosley, Grove, Camberwell, Surrey, engineer,—"Certain improvements in the mode or modes, method or methods, of manufacturing raw sugar from beet roots, and in preparing such roots for that purpose, and in obtaining saccharine matter from such roots when prepared, or in a raw state, and in the machinery or apparatus, and a combination or combinations thereof, applicable for that purpose, parts of which modes or methods, and also part of the machinery and apparatus, with certain adjuncts and combinations, are applicable to the refining of beet and other sugar, and for other useful and manufacturing purposes."—6th.

John Gwynne, Lansdowne-lodge, Notting-hill, Middlesex, merchant,—"Improvements in machinery for pumping, forcing, and exhausting of steam, fluids, and gases, and in the adaptation thereof to producing motion, to the saturation, separation, and decomposition of substances."—16th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 16th April, to 15th May, 1851.

April 16th,	2780.	G. D. Alderson & Co., Blenheim-street, Oxford-street,—"Podonomic refrigerator."
17th,	2781.	T. Edington & Sons, Glasgow,—"Self-acting hot-air range."
—	2782.	J. Welsh & J. Margetson, Cheapside,—"The European cravat."
—	2783.	Parker & Acott, Birmingham,—"Everpointed magnum-bonum pencil."
22d,	2784.	L. Hicks, Leeds,—"Hat."
23d,	2785.	C. Hodges, Devon,—"Ribbon protector or reel."
—	2786.	H. & W. Turner, Sheffield,—"Cyma-rector fire-irons."
—	2787.	T. Glover, Suffolk-street, Clerkenwell,—"Gas-light economic regulator."
—	2788.	H. C. Hurry, Manchester,—"Sheet-glass for covering buildings."
—	2789.	I. Martin, Killyleagh-Mills, Down, Ireland,—"Flax-dressing holder."
24th,	2790.	J. Hughes, Queen-street, Radcliff,—"Liquid ships' compass."
—	2791.	J. Jackson, Bradford,—"Flyer."
April 25th,	2792.	Grigg & Jenkinson, Bunhill-row,—"Fastening for metallic bed steads."
—	2793.	H. Robinson, Castle Warden, Naas,—"Roofing tile."
26th,	2794.	Ainge and Aldred, 126, Oxford-street,—"The Camden archery tablet."
—	2795.	J. Mellor, Manchester,—"Apparatus for indicating the height of water in boilers and the pressure of steam."
28th,	2796.	C. F. O'Toole, Nottingham,—"Military vest."
—	2797.	H. M. Page, Coventry-street,—"Dressing-glass."
29th,	2798.	C. Rowley, Addle-street,—"Instructive card for carding dress-fastenings."
—	2799.	T. J. Baker, Famdon,—"Double power beam-pump."
—	2800.	J. Wright, Chipping-Ongar, Essex,—"Refrigerator."
—	2801.	J. J. Greenin, Brighton,—"Ladies' railway case."
30th,	2802.	Charles J. Watson, Piccadilly,—"Utilis portmanteau."
May 1st,	2803.	Rudhall & Co., Birmingham,—"Penholder."
—	2804.	George Unite, Birmingham,—"Spring and chain fastening for bracelets."
3d,	2805.	Thomas Wallis, Conduit-street, Paddington,—"Railway and Exhibition passenger carriage."
5th,	2806.	E. Wolff & Son, Spitalfields,—"Artists' companion."
7th,	2807.	G. Graham, Leeds,—"Wringing and mangling machine."
12th,	2808.	N. Jones & A. McLenna, Liverpool,—"Tube plug for marine and other tubular boilers."
13th,	2809.	W. Ladd, Walworth,—"Adjustments for microscopes."
—	2810.	T. Gowland, Leadenhall-street,—"Spring catch-fastener applicable to brooches."
—	2811.	L. White, Upper Ground-street,—"Chimney stopper."
14th,	2812.	I. Ireland, Manchester,—"Cupola."
—	2813.	Barret & Brothers, Oxford-street,—"Portmanteau."
15th,	2814.	W. Kirkwood, Edinburgh,—"Water-closet."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 15th April, to 15th May, 1851.

April 15th,	165.	S. Charles, Calthorpe-street,—"Apparatus for cooling and freezing."
—	166.	S. Lowry, St. John-street-road,—"Dead seconds watch."
17th,	167. 168.	R. Howson, Manchester,—"Packing-ring segment for piston safety-valve."
—	169.	E. Dove, Forster-street, City-road,—"Safety envelope."
19th,	170.	W. W. Nicholson, Newark-upon-Trent,—"Cooking stove."
—	171.	C. Bolton, Dorset-street, Portman-square,—"Stitching machine."
—	172.	C. H. Moysen, Calthorpe-street,—"Irrigator to be worked by hand."
22d,	173.	J. E. Townshend, St. George's-place, Camberwell,—"Invalid's bedstead."
—	174. 175.	S. Cox, Walsall,—"Albert stirrup and stirrup leather." "Draw-mouth clipper bit."
23d,	176.	A. Blenkinsop, Waterloo-road,—"Galvanic rod."
—	177.	Chadburn, Brothers, Sheffield,—"Barometer tube."
—	178.	J. F. C. Noel, Calthorpe-street,—"Bit."
—	179.	A. E. Laradoux, Calthorpe-street,—"Pencil cutter."
—	180.	C. H. Moysen, Calthorpe-street,—"Irrigator for making furrows or trenches of fixed dimensions to water the land."
24th,	181.	C. Farrow, Great Tower-street,—"Self-closing valve."
25th,	182.	J. G. Shipley, Regent-street,—"Stirrup leather."
—	183.	T. W. Stapleton, King-street,—"Coffee urn."
28th,	184.	B. Clarke, Chelsea,—"Potato-drying steamer."
—	185.	M. Rabiot, Finsbury,—"Invalid seat, or couch."
—	186.	J. Hancock, 3 Conduit-street,—"Curved instep boot."
—	187.	J. Smith, Hornsey,—"Strawberry pan."
—	188.	J. Smith, Hornsey,—"Hyacinth supporter."
29th,	189.	W. H. Molan, Cranbourne-street,—"Tooth-brushes."
—	190.	J. Firkins & Co., Worcester,—"Gloves."
30th,	191.	G. Myers, Lambeth,—"Window-sashes."
—	192.	H. Bigford, Wolverhampton,—"Slide lever-detector lock."
—	193.	I. Naylor, Yorkshire,—"Bobbin cop motion."
—	194.	E. F. Fourdrinier, Sunderland,—"Penholder."
May 1st,	195.	J. L. Hancock, Goswell-road,—"Shower bath."
—	196.	F. De Porquet, Fenchurch-street,—"Hay and straw-cutting machine, with corn-cutting machine combined."
7th,	197	C. R. Oliffe, Ramsgate,—"Fraud preventor."
—	198	J. Farrell, Dublin,—"Window."
10th,	199	E. Faulkner, York-street,—"Accordion-stand."
—	200	F. Fletcher, Gloucester,—"Apparatus for supplying fire-engines with water."
—	201	W. D. Paine, Thomas-street, Blackfriars,—"Ventilator."
—	202	W. Taylor, Birmingham,—"Banker's security inside shutter-bar."
—	203	W. C. Rickman, Knightsbridge,—"Level."
—	204	W. C. Rickman, Knightsbridge,—"Rod level."
—	205	T. Cook, Plumpstead,—"Alarm for houses."
13th,	206	J. Bonallack, Church-lane, Whitechapel,—"Staves and stays for van and cart bodies."
14th,	207	S. Howle, Aston, near Birmingham,—"Machine for cutting builders' laths."
—	208	J. S. Cockings, Birmingham,—"Match-box."
—	209	C. B. Lewis, Westminster,—"Equilibrator."
—	210	M. Gibson, Newcastle-upon-Tyne,—"Clod-crusher."
—	211	J. Lee, Bread-street Hill,—"Life-preserving and swimming vest."
—	212	T. Wilkins and Son, Sheffield,—"Regulator spring-screw."
—	213	G. Darling, Perth,—"Ventilator for a hat."
15th,	214	E. Dent, Edgbaston, near Birmingham,—"Perforated rim flower-pot."
—	215	T. Powell, Birmingham,—"Flexible union pen and holder."

TO READERS AND CORRESPONDENTS.

C. T.—We shall give the paper in the next number, but we are not in a position to furnish the illustrations at present.

J. B., Carlisle.—We have engraved the figures, but find that they must wait until next month.

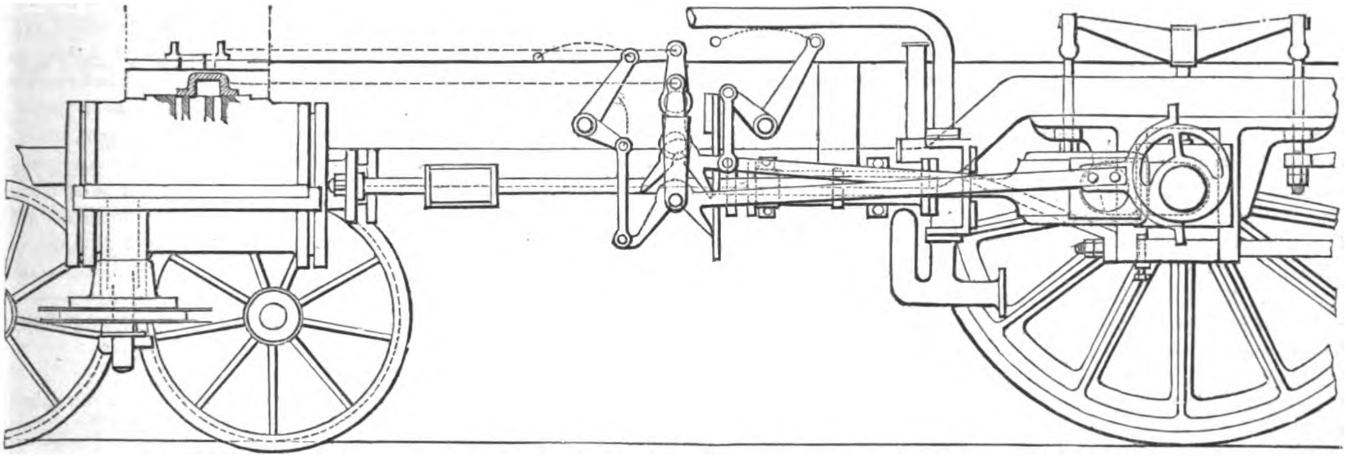
W. J., Llanelly.—It is a difficult matter to name the *best*. The French are our masters in this, as in some other points. We believe their best book will shortly be re-published in this country. When it appears, we will advise him of it.

BURNS—Will have heard from us by post.

W. G. B.—See Encyclopædia Britannica, and Banks' Treatise on Mills.

AMERICAN ENGINEERING.

LOCOMOTIVES.

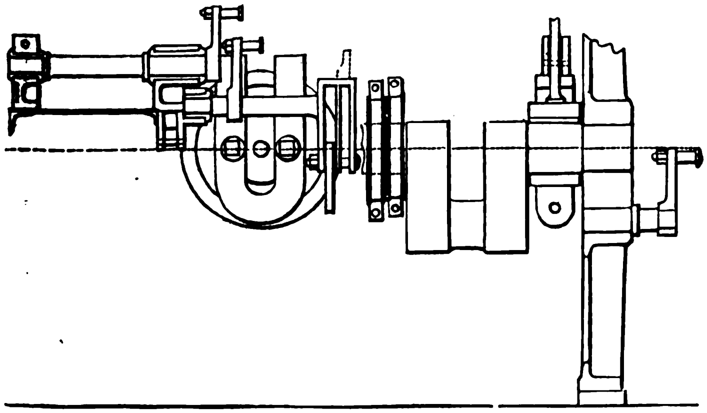


1-24th.

The accompanying drawings present two views or sections of the working gear of the Champlain; one being a longitudinal section through the centre of the engine, showing the forward hook in gear, and the engine at the end of her stroke. The other drawing represents one half section at the crank, and one half at the rock-shaft. They are both so plain as to need no description. The construction and dimensions of the cast-iron driving wheel (with wrought-iron tyre) will be plainly seen on it. We do not deem it necessary to give more views of this engine, as we intend, in the illustrations of the Outside Cylinder Express Engine, to place before the English reader an American locomotive in all its details.

The former description of the Champlain (vol. iii., p. 242) contains an error, which it will be well to correct here. The flues are only $1\frac{3}{8}$ in. diameter instead of 2 in.; this decreases the heating surface to 824·43 square feet.

The size of the main steam-ports is 14 in. × 1 in.; exhaust port, 14 × 2. The main valve has a throw of $3\frac{1}{2}$ in., $\frac{5}{8}$ in. lap on the steam side, and is set with a lead of $\frac{1}{16}$ in. The expansion-valve cuts off at half stroke.



1-24th.

Now, as to her performance:—

The trains here average one baggage-car and five passenger-cars; all the cars are carried on two four-wheeled trucks. The passenger-cars have seats for sixty persons. During the summer season the trains average more cars; and we have often seen the Champlain with from eight to ten and eleven cars, keeping her running time, the cars not merely filled, but crowded with passengers.

In the following calculation we shall assume, as an average below the mark, fifty passengers to a car, and take, as is usually done, thirteen passengers with baggage to average one ton.

An ordinary train in the winter season will weigh—

1 baggage-car at 13,500 lb., ...	13,500
5 passenger-cars at 18,750, ...	93,750
	107,250 lb., or 47·8 tons.
250 passengers at 13 per ton, ...	20
Weight of train exclusive of engine and tender, ...	67·8 tons.

Taking one of the heavier trains—

1 baggage-car, ...	13,500
10 passenger-cars, ...	187,500
	200,000 lb., or 89·2 tons.
500 passengers, ...	31·0
Weight of train exclusive of engine and tender,	120·2 tons.

This is a very heavy train for an engine of that size to propel at a running rate of forty-four miles per hour—on many parts, at nearly sixty miles—(vol. iii., p. 241). The road, compared with other American lines, is favourably constructed in regard to curves and grades, yet there are many curves on it such as will not be found on English roads. If the duties of two engines—one American, and one English—are to be compared, not only their size and weight, and the proportioning of parts, their consumption of fuel and water, speed and load, have to be considered, but also the nature of the road, and the grades and curves. Yet, leaving out of calculation the last two items, it would seem the American *passenger* engine performs more work—there is more work got out of her than is generally obtained from the English *passenger* engines. The speeds are the same, the steam pressure probably the same; the English engine has the advantage of freer exhaust (not being impeded by a spark-arrester), and uses a fuel which, burning slow, and evolving great and lasting heat, requires the furnace door to be opened perhaps only once in four or five miles, whereas, with wood as fuel, it is open about one-third of the whole time, thus introducing a great quan-

tity of cold air into the furnace, which is no advantage to the evaporative power of the machine.

But, on the other hand, the American *passenger* engine has many solid advantages in its construction. The almost universal use of double drivers is one of them. Where the trains are very light, as the express trains generally are on English lines, a powerful single driver engine may be very well, with the few stoppages such trains make. These trains have, however, not been found profitable; they would be more so if the engines allowed heavier trains. The above performance of the Champlain, for instance, compares very favourably with the single driver outside cylinder engines of Messrs. Sharp & Co., which, in many dimensions, is similar, and of which, in Mr. Barlow's description (in Tredgold), it is said, with a load of about forty tons, her running speed was thirty-seven miles, but with a load of seventy tons she only attained twenty-six miles. There is little difference in their weights.

For the propulsion of a train, a certain amount of adhesion is required. This depends on the incipient weight on the driving wheels. By dividing it among four wheels instead of two, a little more frictional surface is obtained certainly, but this is not to be compared with the saving of frictional resistance by dividing the weight among four bearings instead of two. This, coupled with the use of the equalizing beam between the springs of two drivers, (which keep the same amount of weight on each wheel constantly, instead of an always changing load,) will cause the machinery to work more free and easy, and prevent slipping, which is a relative gain of power, for it is a diminution of resistance, and, at the same time, a saving of wear and tear, and thus of repairing expenses.

The use of four-wheeled trucks on engine, tender, and cars, is another source of saving of power; for such cars run much easier than they would with rigidly fixed axles, as in England, for lateral straining and friction against the rails in curves is in great part obviated. It cannot, in opposition, be pretended that the use of trucks is unsafe, when the whole railroad experience of America proves the reverse, even at the highest speeds.

The disadvantage of overhanging weight in front of the engine, in producing great oscillation, has been acknowledged by the introduction of another front axle in engines of the Iron-Duke class: it is to be hoped that this is one step forward towards the adoption of a truck.

The consumption of fuel by the Champlain averages 4¾ cords of wood per double trip of 144 miles, one cord being equal to 128 cubic feet. The wood used is Georgia pine.*

As it is so long a time since the first notice of the Champlain was written, it may not be uninteresting to notice the work since done by her, for it will show that she has continued running with the same regularity.

We stated then that she had run, up to the end of September last year, 29,379 miles: her running since then has been in—

October,	1850,	3096 miles.
November,	—	2880 —
December,	—	2188 —
January,	1851,	3384 —
February,	—	2736 —
March,	—	2448 —

She has thus run, in fifteen months and a half, 46,111 miles. The expenses for repairs have been tolerably low, and average 2½ cents (about 1¼d. English) per mile run.

Our next illustrations of American engineering will consist of drawings and description of the Locomotive Condensing Engine, in use on the Hudson River Railroad for city traffic—the first of its kind—which, two years ago, was still generally considered as a mere chimera—a thing to be desired, but impossible to make. It was put on the line last summer by Mr. Waterman, who invented, designed, and built her as an experiment, and, since the beginning of this year, has been in constant, steady, and successful operation. Although, from the difference of constructing roads through towns in America and England, she may not be of use in this country, yet we may hope that, as a novelty, an ingenious and economical machine, she will command the interest and attention of English engineers.

* The Champlain is excelled by one or two other engines on this line in economy of fuel —there are others consuming only from 3½ to 3¾ cords.

In the experiments on the coal-burning engines on the Reading railroad, it was ascertained that two cords of wood are equal, in evaporative power, to 1·87 tons of hard coal. In "*Knapp's Chemistry applied to Manufactures*," we find the following table of the relative economic value of various fuels:—

POUNDS OF WATER HEATED FROM 0° TO 100° (CELSIUS) BY 1 lb. FUEL.

Newcastle caking coal,	70·0
Coke (best French),	65·6
Pine,	31·0
Pennsylvania anthracite,	69·1

Weight of a cubic foot of American pitch pine (from Barlow's table), average 50 lbs.

ON POISONS, THEIR PROPERTIES, EFFECTS, DETECTION, AND ANTIDOTES.

I.

The science of chemistry, in its modern guise, has become recognised as being closely interwoven, as well with the meanest as with the highest industrial pursuits. In our age, we are constantly told that a knowledge of it is no longer to be confined to any individual professions, arts, or manufactures, climate or country. Wherever there is animal or vegetable life—throughout the domains of fire, air, earth, and water—chemical agencies are in continual operation, sustaining the life, order, and harmony of the whole.

Throughout the immensity of its range, there is no department which imports more to man than that of toxicology, or the testing and discovering of the spurious commodities and adulterations, with which, unfortunately, commerce is too closely beset. Amongst the numerous schemes which the wickedness of human nature has devised for the destruction of human life, we can fix upon no weapons so deadly, or which have been so lavishly wielded, as those which the study of chemistry has unfolded. But if the science yields the instruments of massacre, it must not be forgotten that it furnishes the means for the detection of crime; nay, more, that it presents us with the antidote.

It is a lamentable fact, that the necessaries and luxuries of life are alike contaminated with foreign matters, the use and adaptation of which could only have been laid bare by an energetic pursuit of the science of adulteration. And to such an extent is the system now carried out, that cases not unfrequently come before us, in which the dishonest vender has palmed off his wares as genuine, when analysis has shown them to be guiltless of the presence of a single atom of the material, by the name of which they have been sold. It is true that such substitutions and adulterations are by no means so directly destructive to life, or so horrifying to the mind, as the cruel and precipitate means often practised for a purpose independent of mere fraud; yet, in many instances, the effects, though slow, are by no means less certain, and often result in fatal diseases. Not only on this account have we to urge the value of a general knowledge of deleterious bodies, for how often are we emphatically reminded of the importance of such information by reports of death from swallowing poisons by mistake! Such errors most commonly arise from ignorance of the chemical nature of substances in ordinary use—an evil which is now easily remedied by lessons to be found in the cheapest elementary books. The earlier writers on toxicological subjects, have not confined themselves to any specific arrangement of the heads of their subject, therefore we shall probably not be deemed eccentric in choosing our own system. In the following paper, then, we propose to divide the poisons into classes, in correspondence with Nature's three kingdoms—mineral, vegetable, and animal—not that this plan of division is by any means the most scientific, but because we conceive it to be the simplest and most convenient.

Beginning with the minerals, we shall place arsenical preparations at the head of the chapter. Arsenic is a steel-grey tinted metal of a brilliant metallic lustre; it is crystalline and extremely brittle; tarnishes rapidly when exposed to the air, but may be preserved unchanged in distilled water. Its density is 5·7 to 5·9. When exposed to a high temperature, it burns with a blue flame. Heated in a glass tube, it sublimes without fusion, attracting the oxygen of the atmosphere, and becoming converted into arsenious acid, whilst the vapour has the identical odour of garlic. Arsenic combines with metals in the same way as phosphorus and sulphur—the former of which it closely resembles in many points. No basic oxide of arsenic has yet been discovered; but it combines in two proportions, forming arsenic and arsenious acids. Its

symbol is A.S., and its equivalent, 75·21. Arsenious acid—white oxide—or the arsenic of the shops, is the most important compound of metallic arsenic. It is a heavy and beautifully white glassy substance, yet it is the grim prince of poisons. Like the viper, its appearance is beauteous to the sight, but a dark and malignant venom lurks within it. The newspaper reports are ever telling us of the readiness with which it is procured by any one who asks for it, under the pretence of requiring it for one or other of a number of domestic purposes; and the same all-seeing authorities advise us of the terrible frequency of its administration under the mask of domestic comfort, or pretended affection. It is, therefore, in the hands of evil-disposed persons, a secret and most deadly instrument. Cold water dissolves but a small portion of arsenious acid; in hot fluids, it is easier of solution. Alkalies dissolve it freely, forming arsenites which do not crystallize; and it is also soluble in hot hydrochloric acid. Its vapour is colourless and inodorous, and, on cooling, it crystallizes into octohedrons; its taste is feebly sweetish and astringent.

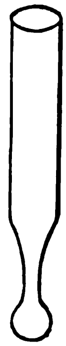
With this glance at the characteristics of arsenious acid, let us now detail the known methods of detecting its presence. Where a white powder has been found under suspicious circumstances, it should be submitted to the processes following:—1st. Mix a little of the suspected powder with twice its quantity of black flux,* and convey it to the bottom of the test tube, by means of a trough or slip of writing-paper, to prevent any of the mixture from coming into contact with the sides of the tube. A paper plug is then put loosely into the tube, which is to be exposed to the flame of a spirit-lamp. If the powder under test should be partly or wholly composed of arsenic it will vaporise, rising up and becoming condensed in the upper and cool part of the tube, leaving metallic traces of a brilliant steel-grey colour. 2d. If the part of the tube, having upon it the metallic film, is held at the distance of about $\frac{3}{4}$ inch above the flame of a small spirit-lamp, the metal will again sublime, and, combining with the oxygen of the air in the tube, will produce well-defined crystals of arsenious acid at another part of the tube.

Dr. Turner ascertained that this experiment is capable of exhibiting the characteristic form and properties of arsenious acid, although the weight of the poison may not exceed the one-hundredth part of a grain. If the suspected substance be a liquid, a stream of sulphuretted hydrogen gas passed through it, will give a yellow precipitate if it contains arsenious acid. This precipitate being collected upon a filter, and washed repeatedly with water and dried, may be reduced to the metallic state by the assistance of black flux. The sulphuretted hydrogen gas is prepared by putting equal weights of powdered sulphuret of iron and sulphuric acid, diluted with three times its weight of water, into a retort, or bottle with a bent tube, the mixture being submitted to a gentle heat to evolve the gas. By another plan, powdered sulphuret of antimony, mixed with five times its weight of strong hydrochloric acid, may be used for making a very pure gas; but the first process is the most convenient. A solution of nitrate of silver, added to arsenious acid in water, produces nothing more than a faint cloud; but if a drop or two of liquid ammonia be added, yellow arsenite of silver is precipitated. Sulphate of copper does not precipitate a solution of arsenious acid until an alkali is added, when a brilliant yellowish-green precipitate results. It is perhaps necessary to mention, that both of these precipitates are extremely soluble in an excess of ammonia; consequently, the alkali must be added with great caution.

Liquid sulphuretted hydrogen added to a solution of arsenious acid, to which a few drops of hydrochloric or sulphuric acid have been previously added, gives a copious yellow precipitate (or pigment), which is readily dissolved by ammonia, and re-precipitated by acids. When a single drop of arsenious acid is placed upon a slip of glass and gently heated, and afterwards placed upon the stage of a powerful compound microscope, the microscopic examination will show a development of regular crystals of arsenious acid, and their characteristic form may be made out, although the drop should not contain the one hundred thousandth part of a grain of the acid. Again, place a little of the suspected liquid on a piece of platinum foil, and touch it with a piece of zinc—whatever arsenic may be in the fluid will be immediately deposited upon the platinum in a metallic form. Mr. E. Davy, who first pointed out this simple test, tells us that he "was enabled by it to detect the presence of arsenic, showing its characteristic properties, with the five hundredth part of a grain."

The voltaic battery, made to act by two wires upon a little arsenious solution placed on a piece of glass, developes metallic arsenic at the cathode or negative pole, and if the wire is copper, the action will whiten it like tombac. The whole of these experiments jointly give demonstrative proof of the presence of arsenic, and are easy of performance, whilst they may be employed, with great precision, upon very minute quantities of material. It is, however, another and far more difficult affair to detect arsenious acid in such complex mixtures as are often met with in cases of poisoning, where a variety of animal and vegetable substances are intimately blended together. Besides, a considerable amount of saline matter may be expected to be present in the fluid contents of the stomach, interfering very much with the results of the liquid tests. The only satisfactory mode of procedure is, first, to make a diligent search for fragments of solid arsenious acid in the contents of the stomach. If anything suspicious is met with, it must be washed, by decantation with cold water, dried, and reduced with charcoal. In delicate experiments for operation on minute quantities, the Berzelius reduction tube, fig. 1, answers best. The suspected liquid is dropped to the bottom of the tube, and is covered over with charcoal fragments up to the shoulders, when it is heated gently—any moisture of evaporation being wiped off the sides of the tube with bibulous paper. The narrow point of the tube containing the charcoal, is then heated to redness in the flame of the blow-pipe; after which the tube is inclined, to allow the bottom to be heated. If arsenic is present it will evaporate, and a ring of metallic arsenic will be formed in the cool part of the tube. The tube may now be melted in the blow-pipe flame, a little beneath the arsenic—drawn off, and closed, and the metallic arsenic oxidised to arsenious acid by chasing it up and down the tube with the flame of a spirit-lamp. A small portion of the arsenious acid, taken from the side of the tube with a penknife, will betray the octohedral character of the crystals under the searching effect of the microscope. The arsenious acid remaining in the tube may be dissolved by heating water in it over a spirit-lamp flame, and, with this solution, the tests of ammoniaco-nitrate of silver, ammoniaco-sulphate of copper, and sulphuretted hydrogen gas, may be applied as we have before described.

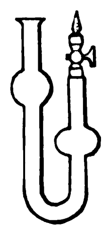
Fig. 1.



If the search for solid arsenious acid should be fruitless, the liquid must be made the subject of investigation. A most successful plan is to add a measured ounce of pure sulphuric acid to a pint of the liquid under test—the mixture being put into a flask and boiled for an hour, or until a perfect separation of the solid and liquid matter becomes apparent. The action of the sulphuric acid converts the starch into sugar and dextrine, if any is present, whilst it coagulates albumine and caseine in the case of milk, rendering the whole easily filtered. After filtration, a current of sulphuretted hydrogen is passed through the liquid, and a precipitate of sulphuret of arsenic falls in combination with a large quantity of organic matter. If heat is applied during the process, the decomposition of the sulphuret will be greatly facilitated. The precipitate is to be collected upon a filter, transferred to a capsule, mixed with a quantity of nitric and hydrochloric acids, and then heated by a spirit-lamp, when the organic impurities will be, to a great extent, destroyed, and the arsenic oxidised to arsenious acid. When the solution is evaporated to dryness, a quantity of diluted hydrochloric acid is added to take up the soluble portion, and a current of sulphuretted hydrogen is again passed through it, precipitating a sulphuret of arsenic. Heat is then applied to the solution; the precipitate is washed by decantation, dried, mixed with black flux,† and submitted to the reduction process already detailed.

The late Mr. Marsh's admirably delicate test is well known, and extensively practised by medical men, and must not be forgotten here. Slips of zinc are placed in the lower bulb of the instrument—fig. 2—and the stop-cock being closed, the suspected liquid, after acidulation with sulphuric acid, is poured into the other end of the instrument. The action of the acid upon the zinc decomposes the water, and hydrogen gas is liberated. The hydrogen combines with the arsenic, if any is present, and collects in the upper part of the lower bulb, forcing the liquid into the upper bulb; and the hydrostatic pressure thus arising, expels the gas through the jet the moment the stop-cock is opened. The gas is then ignited, and a piece of porcelain is held in the flame. Now for the test. Should there be any admixture of arsenurieted hydrogen, it will make its appearance on the porcelain as a brilliant black spot of reduced arsenic.

Fig. 2.



If the liquid to be tested is acidulated with hydrochloric acid, and then boiled in a flask with a piece of copper foil in it, the copper withdraws the arsenic, and becomes coated with a white alloy of arsenic. Sublimation of the arsenic at once takes place, on heating the metal in a glass tube. Instead of boiling the poisonous liquid with the copper, the agency of electricity may be employed, by attaching a piece of platinum to the

* Obtained by the calcination of cream of tartar in a close crucible.

† A mixture of anhydrous carbonate of soda and charcoal is less hygroscopic than black flux, and, consequently, may be substituted for it with advantage.

silver end of a Smee's battery, and a piece of copper to the zinc end, the metals then being placed, at a short distance apart, in the liquid to be tested. If arsenic is there, it will speedily make its presence known by a silvery lustre on the copper. When the copper so coated is detached from the battery, it is placed in a glass tube to expel the arsenic as before.

It must be remembered, that both the zinc and sulphuric acid of commerce, often contain traces of arsenic themselves. We may also hint that the operator should never employ any substances, or re-agents, for the detection of poisons, until he has satisfied himself that they are genuine, or he may arrive at most fallacious results.

GENERAL OBSERVATIONS ON THE PRINCIPLES OF THEORETICAL MECHANICS. *

In all the fundamental notions of this science, the abstract and concrete points of view are continually confounded. This confusion stands in the way of a clear distinction between what is really physical and what is purely logical, and of an exact separation of artificial conceptions only used to facilitate the establishment of the general laws of equilibrium and motion from the actual facts of observation, which alone constitute the real basis of the science. The great advance of the science during the last century, both as regards the extension and the co-ordination of its theories, has in some degree operated injuriously upon a philosophical conception of the science, the present mode of presenting which is much less neat than that of Newton. The advancing use of analytical mathematics has led to the treatment of mechanics as containing only simple questions of analysis; and hence it has been attempted to establish the fundamental principles of the science, *à priori*, according to considerations purely analytical, those principles which Newton wisely presented as solely the results of experiment. If, however, it were possible to form the entire science by means of purely analytical conceptions, it would be difficult to see how it could be truly applicable to the study of nature. The reality of theoretical mechanics, on the contrary, is precisely established by this, that it is based upon certain general facts directly supplied by observation and experiment. I now propose to indicate how, in the present state of the science, its true philosophical character may be neatly established; and to show how it may be freed from all metaphysical influences, by constantly distinguishing an exact separation between the purely experimental part and the part purely logical. We will begin by indicating, with precision, the general object of the science.

It is not within the province of mechanics to consider the first cause of motion, nor even the circumstances of its production. These, although forming an interesting subject of research in the different departments of physics, are by no means the mainspring of mechanical science, which is limited to an examination of motion in itself without inquiring into its origin. Forces, in mechanics, are therefore nothing but motions produced, or tending to be produced; and two forces which impress on the same body the same velocity in the same direction, are regarded as identical, however different may be their origin, and whether the motion proceeds from the muscular contractions of an animal, or from gravitation towards an attracting centre, or from the blow of some body, or from the expansion of an elastic fluid.

This being premised, we can very precisely characterise the general problem of theoretical mechanics, as consisting in determining the effect produced upon a given body by several forces acting simultaneously, the simple motion resulting from the isolated action of each being known; or reversing the problem in determining the simple motions, the combination of which would give rise to a known compound motion. This definition shows exactly what are the necessary data, and the unknown quantities of every mechanical problem. It is seen that the study of the action of a single force is never, to speak accurately, within the domain of theoretical mechanics; it is always supposed to be known, for the second general problem is not susceptible of solution except as the inverse of the first. All mechanical science, therefore, essentially relates to the combination of forces, whether it be that we need to investigate the different circumstances of motion resulting from that combination, or that, by their mutual distinction, the body is placed in a state of equilibrium, the conditions whereof are to be determined.

These two general problems—one direct, the other inverse—have, with reference to a practical application, an equal importance; for sometimes simple motions can be directly studied from observation, whilst the knowledge of the motion which would result from their combination can only be obtained by calculation; sometimes, on the contrary, the compound motion can alone be observed, whilst the simple motions, of which we can regard it as compounded, do not fall within the range of observation. The oblique fall of a heavy body to the earth's surface will furnish us with an example. The two simple motions which such a body would take by the isolated action of each of the forces impelling it, namely, the direction and the velocity of the uniform motion which the projecting force alone would generate, and the law of the accelerated motion in a vertical direction produced by gravity alone, are known to us; whereupon it is proposed to discover the different circumstances of the compound motion produced by the combined action of these two forces—that is to say, to determine the trajectory which the moving body will describe, its direction, and the velocity acquired at each instant, the time occupied in attaining a certain position, &c. Celestial mechanics offers us an instance of the inverse problem, in the determination of the forces producing the motion of the planets around the sun, or of the satellites around their planets. We cannot know directly that the motion is compound. Starting from the characteristic circumstances of this motion—circumstances such as the laws of Kepler expressed—we may get at the elementary forces by which the stars may be conceived as influenced, so as to bring about their real motions. These forces once known, geometers can usefully survey the problem from the opposite point of view, which it had originally been impossible to do.

The true aim of theoretical mechanics being thus neatly conceived, let us now consider the fundamental principles on which it rests, examining, in the *first* place, a philosophical artifice of the highest importance as to the manner in which bodies are to be surveyed in this science. It would be utterly impossible to establish any general proposition as to the abstract laws of equilibrium or motion, if we did not begin by regarding bodies as absolutely *inert*—that is, as quite incapable of spontaneously modifying the action of forces applied to them. But the manner in which this fundamental conception is usually presented, appears to me radically vicious. At first, this abstract notion, which is nothing but a simple logical artifice contrived to facilitate the formation of the science, or rather to render any science possible, is often confounded with what is improperly termed the *law of inertia*, which must be regarded as a general result of observation. In the *second* place, the idea conveyed is commonly so vague, that we fail to gather whether this passive condition of matter is purely hypothetical, or whether it represents a real state of things. *Finally*, it frequently happens that the mind is involuntarily led to regard the general laws of mechanics as exclusively applicable to what is termed brute matter, whilst, in fact, they are also found in operation in organized bodies, although their application is in them surrounded by much greater difficulties.

This passive condition of matter is indeed a pure abstraction, directly opposed by its real constitution, yet the hypothesis is indispensable to the establishment of the abstract laws of equilibrium and motion. When a science of abstract mechanics has been founded by assuming the passivity of matter, we can afterwards pass to concrete mechanics by restoring its real active properties. This step forms, in truth, the principal difficulty in passing from the abstract to the concrete in mechanics—a difficulty which very much limits the important applications of the science, the theoretical range of which is in itself necessarily indefinite.

The fundamental laws of motion are reducible to three, which must be considered as the result of experience, and not as capable of being established by *à priori* reasoning, although that has often been attempted.

The first law, improperly designated the law of inertia, was discovered by Kepler. It really consists in this—that all motion is naturally rectilineal and uniform; that is, that every body subjected to the action of a single force acting instantaneously, will constantly move in a right line with invariable velocity. The influence of the metaphysical spirit is especially manifested in the mode in which this law is commonly presented. Instead of regarding it as a fact derived from experience, it has been attempted to demonstrate it by an application of the principle of sufficient reason, which has not the least solidity. An examination of the argument, however, will show that the pretended explanations are nothing more than the repetition, in abstract terms, of the fact itself, viz., that bodies have a tendency to move in right lines—the very proposition to be established. When the law is stated as derived from experience, its validity is proved by the commonest facts. We have continually occasion to remark, that when a body is influenced by a single force, it constantly moves in a right line; and if it should be seen to deviate, whilst in motion, from that line, it will be easy to show that this deviation is due to the simultaneous action of another force, active or passive. Curvilinear motion was thought by the ancients to be the simple and natural motion of the stars, on the ground that it was the most perfect kind of motion. But an examination of curvilinear motion will clearly prove, from the varied phenomena due to what is termed the centrifugal force,

* An abridged chapter of Auguste Comte's *Philosophie Positive*. Dr. Brock's article, "A First Chapter in Mechanics," (Prac. Mech. Jour., vol. iii., p. 98,) may be advantageously consulted by our younger readers during their perusal of these observations.

that bodies ever preserve their natural tendency to move in a right line. In fact, there is no phenomenon in nature which cannot furnish a verification of this law, upon which is in part founded all the economy of the universe. And it is the same as regards the uniformity of motion. Facts prove to us, that if the motion originally impressed should gradually abate, and finally cease, that proceeds from some resistance which bodies meet with. If there were no obstacles, experience tells us that the velocity would continue constant for ever. By diminishing these obstacles, we can very considerably prolong the motion. A pendulum which, under ordinary circumstances, will not continue to vibrate longer than a few minutes, will vibrate under an exhausted receiver for upwards of thirty hours, provided we diminish friction as far as possible at the point of suspension. A manifest proof of the natural tendency of bodies to preserve indefinitely the velocity they have acquired, is derived from the invariability with which the movements of the heavenly bodies are carried on. Since the time when they were first accurately observed—about 2000 years ago—not the slightest alteration has taken place either in the duration of their rotations, or in that of their revolutions.

It must, therefore, be regarded as a grand law of nature, that all bodies have a spontaneous tendency to move in a right line with a constant velocity. Considering the confused ideas with which this fundamental principle is contemplated, it may be useful to remark, that the law is just as applicable to living bodies as to brute matter, to which it is often thought to belong exclusively. Whatever be the origin of the impulse received, a living body has a tendency to persevere, like inanimate matter, in the direction of its motion, and to preserve the velocity acquired; only there are developed in it other forces capable of modifying or extinguishing that motion, whilst, in dead matter, the modifying causes are external to it. But, in this case even, we have a direct and personal proof of the universality of the law, in the effort we are obliged to make in order to change the direction, or the velocity of our motions. Whenever our motion is a very rapid one, it is impossible to modify or stop it at the exact moment we desire.

The second fundamental law of motion, discovered by Newton, is, that there is a necessary and constant equality between action and reaction—that is to say, that whenever one body is set in motion by another body, the former acts on the latter in a contrary direction, so that as much motion is lost to the impelling body as is gained by the one impelled. It has sometimes been attempted to establish, *à priori*, this general theorem of natural philosophy, with no better success, however, than in the case of the preceding. This equality in the reciprocal action of bodies is manifested in all natural phenomena, whether bodies act on one another by impulsion or by attraction.

The third law of motion appears to me to consist in what I propose to call the principle of the independence, or the co-existence of motion, which leads directly to what is commonly termed the composition of forces. Galileo was the real discoverer of this law. Considered under the simplest point of view, we arrive at the general fact, that any motion common to all the bodies of a system does not alter the particular motions of the different bodies composing that system with regard to one another, but that they will continue to perform such particular motions as if the whole system were motionless. In order to enunciate this important principle with full precision, we must imagine that all the points of the system simultaneously describe equal and parallel right lines, and consider that this general motion, no matter what may be its velocity or direction, will in nowise affect the relative motions.

It would be in vain to attempt to establish this law *à priori*, any more than the two preceding. At most, one might conceive that if the bodies of the system are in a state of repose as regards themselves, a displacement common to all would have no effect upon their respective mutual distances or situations, and would not change their relative immobility; but our total ignorance of the intimate nature of bodies and phenomena will not permit us to affirm positively, that the introduction of this new circumstance will not modify, in some unknown manner, the original conditions of the system. Moreover, the insufficiency of such an argument becomes quite apparent when we attempt to apply it to the most extensive and important case—to that where some of the bodies of the system are moving as regards each other. This law can then be really established only by experience. No proposition of natural philosophy is founded on observations more simple, various, and easy of verification. There is not a single dynamical phenomenon which does not offer a proof of it, and all the economy of the universe would be completely overturned if we supposed this law to exist no longer. For instance, during the advancing motion of a vessel, whatever be its rapidity and direction, all relative motions continue to take place exactly as if the vessel were stationary, leaving out of view the results of rolling and pitching, and taking into account the general motion as regards a spectator who does not share in it. Again, the motion of the terrestrial globe in no degree disarranges the mechanical phenomena taking place on its surface, or in its interior. Ignorance of this law was the chief scientific obstacle to the establishment of the theory of Copernicus. Laplace remarks, that if the general motion of the earth could alter, in any manner, the particular motions taking place on its surface, the alteration would evidently not be the same for all such motions, for these would necessarily be diversely affected according as the angle made by the direction of the particular motion with that of the globe's motion was more or less great. Thus, for instance, the oscillatory motion of a pendulum ought then to present very considerable differences according to the azimuth of the vertical plane in which it takes place, and which gives it at one time a direction conformable with, at another contrary to, and very unequally contrary to, that of the earth's motion, whilst experience never manifests to us the slightest variation even in measuring the phenomenon with the greatest accuracy.

To prevent an erroneous interpretation, and a vicious application of this third law, it is requisite to remark that, by its nature, it only relates to motions of translation, and not at all to those of rotation. Motions of translation are the only motions which can be strictly common, as well in degree as in direction, to all the different parts of any given system. This exact parity can never take place in bodies having only a rotatory motion, which necessarily occasions inequalities amongst the different parts of the system, just as they are more or less distant from the centre of rotation. Hence, every motion of this kind constantly tends to alter the state of the system; and it does alter that state, if the conditions of union between the different parts do not offer a sufficient resistance. Thus, for instance, in the case of a vessel, it is not the general progressive motion which disarranges the particular motions, the disarrangement is owing to the secondary effects of rolling and pitching, which are motions of rotation. Let a watch be simply conveyed in any direction, with as much rapidity as you like, but without being turned round, it will not be affected in the least, whilst a slight motion of rotation will suffice to derange its internal movements immediately. It is in consequence of such a distinction that we have no means of verifying, by purely terrestrial phenomena, the reality of the earth's motion of translation, which was only discovered by celestial observations; whilst, in relation to its motion of rotation, it necessarily determines at the earth's surface by reason of the inequality of the centrifugal force between the different points of the globe—phenomena which, though inconsiderable, are quite sensible; the analysis of which is sufficient to demonstrate, independently of astronomical considerations, the existence of this rotation.

The principle of the independence or co-existence of motions being once established, it is easy to see that it immediately leads to the rule in ordinary use for what is commonly termed the composition of forces, which is really nothing but another method of considering and enunciating the third law of motion. In truth, the proposition of the parallelogram of forces properly consists in this, that when a body is influenced at the same time by two uniform motions in any direction whatever, it describes, by virtue of their combination, the diagonal of the parallelogram of which it would, in the same time, have separately described the sides by virtue of each single motion. Now, have we not evidently here a simple direct application of the principle of the independence of motions, according to which the particular motion of the body along a certain right line, is in no degree disturbed by the general motion which draws the whole of that right line parallelwise to itself along any other right line whatsoever? This consideration leads at once to the geometrical construction enunciated by the rule of the parallelogram of forces. It is thus that this fundamental theorem of theoretical mechanics appears to me to be directly presented as a law of nature, or at least as an immediate application of one of the great laws of nature. Such is, according to my opinion, the only mode truly philosophic of establishing this important proposition on a firm basis, of finally dissipating all the metaphysical clouds with which it is still surrounded, and of placing it beyond the reach of objection.

The importance of this proposition warrants me placing it under another point of view. For this purpose, it is sufficient to recognise that this law, instead of being directly expounded in the introductory part of the science, has been of late admitted by all geometers as proving the principle of the proportionality of velocities to forces, the basis of dynamics. In order to seize the true character of this problem, we must remark, that the ratios of the forces can be determined in two ways, either statically or dynamically. It is not always that we measure the ratio of two forces by the greater or less intensity of the *motions* which they give to a body. We frequently measure it by simple considerations derived from *equilibrium*, regarding as equal those forces which, applied in contrary directions in a right line, are reciprocally destructive, and then as double, triple, &c. of another, that force which would balance two, three, &c. forces equal and directly opposed to the former. This pre-

mised, the problem essentially consists in knowing if the two modes are always and necessarily equivalent—that is to say, if the ratios of the forces obtained by the statical method will impress on the same mass velocities which are exactly proportional. This correlation is by no means self-evident; at most, we may conclude, *à priori*, that the greatest forces must necessarily give rise to the greatest velocities. But observation alone can ascertain whether it is to the first power of the force, or to some other increasing function, that the velocity is proportional.

It is for the determination of what is in this respect the true law of nature, that, by the admission of all geometers, we must consider the general fact of the independence or coexistence of motion. It is easy to see, from the reasoning of Laplace, that the theory of the proportionality of velocities to forces is a necessary and immediate consequence of that general fact applied to two forces acting in the same direction. For if a body, by virtue of a certain force, has traversed a certain space, following a certain right line, and we add a second force equal to the first, and acting in the same direction, this new force, according to the law of the independence of motion, would only operate to displace the whole of the line by an equal quantity in the same time without altering the motion of the body along that line, so that, by the composition of the two motions, that body would, in fact, have traversed a space the double of that which corresponded to the original force.

It is evident, then, that when we supposed we might dispense with the general fact of the independence of motion, in order to establish the fundamental law of the composition of forces, the necessity of regarding this proposition of natural philosophy as an indispensable base of the science, inevitably comes forward again to demonstrate the no less important law of forces proportional to velocities, which places this necessity beyond all dispute. What has been the result of all attempts to avoid introducing directly, in the prolegomena of the science, this fundamental observation? Only to seem to dispense with it in statics, and to take it into consideration as soon as we arrived at dynamics. Therefore the whole is resolved into a simple transposition. It is clear that a result of such slight importance is in no degree proportional to the complication of the indirect processes employed to compass it, even if these processes had been unobjectionable; and we have expressly declared the contrary. It is, therefore, in all respects, much more satisfactory to admit at once the philosophical necessity of the science; and since there must be an experimental basis, to recognise that basis at the beginning.

Such, then, are the three physical laws of motion, which supply a sufficient experimental basis to theoretical mechanics. On this basis the human mind, without again referring to the external world, can systematically build up the science. All the mechanics of uniform motion or instantaneous forces can be wholly treated as a direct consequence of these laws, which, being very precise in their nature, are capable of being expressed by analytical equations easy to obtain. As to the most extensive and most important part of mechanics, wherein lies the real difficulty of the science—the mechanics of variable motions and continuous forces—we may conceive, in a general manner, the possibility of applying the infinitesimal method to elementary mechanics, the character of which we have vindicated. During each instant, infinitely small, a uniform motion may be substituted for a variable motion, and hence we get differential equations for the latter kind of motions.

The first and most important division of mechanics is into statics and dynamics. The conditions of equilibrium are considered in one, the laws of motion in the other. It is easy to conceive, *à priori*, that the problems of statics must be more easy to deal with than the problems of dynamics, —the reason being, that, in the first, *time* is not taken into account; in other words, the phenomena being instantaneous, there is no need to attend to the variations which the forces of the system might undergo in different successive instants. In dynamics, this element constitutes the principal difficulty.

The next division, in point of importance, consists in separating, both in statics and dynamics, the study of solids from that of fluids. The essential principles of statics and dynamics are necessarily the same, both for solids and fluids; but the latter require the addition to characteristic conditions of the system, one consideration the more—that connected with variability of form, which generally defines their peculiar mechanical constitution. This additional consideration undoubtedly increases the difficulty of the problems; for that perfect incoherence of the separate particles which characterizes fluids, obliges us to consider each particle separately, and consequently to contemplate always, even in the simplest case, a system compounded of an infinity of distinct forces. It follows, that for statics a new order of inquiries is introduced as to the figure of the system in a state of equilibrium—a very difficult question—the general solution of which has advanced very little, even for the single case of gravitation. But the difficulty is much more sensible in dynamics, seeing that the necessity of separately considering the motion peculiar to each particle brings into the question, contemplated under an analytical point of view, a great degree of complication, which has only been overcome in the very simple case of a fluid solely influenced by gravity, by the help of highly precarious hypotheses.

Moreover, it is to be remarked, that the mathematical definitions, both of solids and fluids, do not correspond with the reality. As to fluids, it is manifest that their particles are not in that state of perfect independence, one of another, which is assumed to be the case. On the contrary, a large number of natural phenomena are due to the mutual cohesion of the particles. This cohesion, which is left out of view in consequence of the almost total impossibility of taking it into consideration, occasions very sensible differences between actual and theoretical phenomena; for instance, as to the flow of a liquid through a given orifice, in which case observation and theory arrive at different results as to the waste in a given time. Again, as to solids, the necessity frequently arises of taking into account the possibility of their cohesion giving way under a sufficient force, whilst, in theoretical mechanics, this possibility is kept out of sight. The truth is, that there is a blank in the science as to the theory of a class of bodies which are neither solids nor fluids, but between the two; for instance, a mass of sand and a gelatinous fluid.

WATT'S PNEUMATIC ELEVATOR.

(*Illustrated by Plate* 74.)

We this month present, in plate 74, three views of one of the modifications of lift-apparatus, referred to in our previous abstract of Mr. Watt's specification.* The patentee states, in his description, that this arrangement is proposed "for the performance of lifting, lowering, and transporting operations in various situations, such as in rivers and harbours, to facilitate the loading and discharging of vessels and other floating bodies, and for raising excavated materials for deposit on the banks."

In the example before us, the contrivance is represented as applied for raising loaded punts of earth-waggons from the water-level of a river or harbour, for discharge upon the pier or bank.

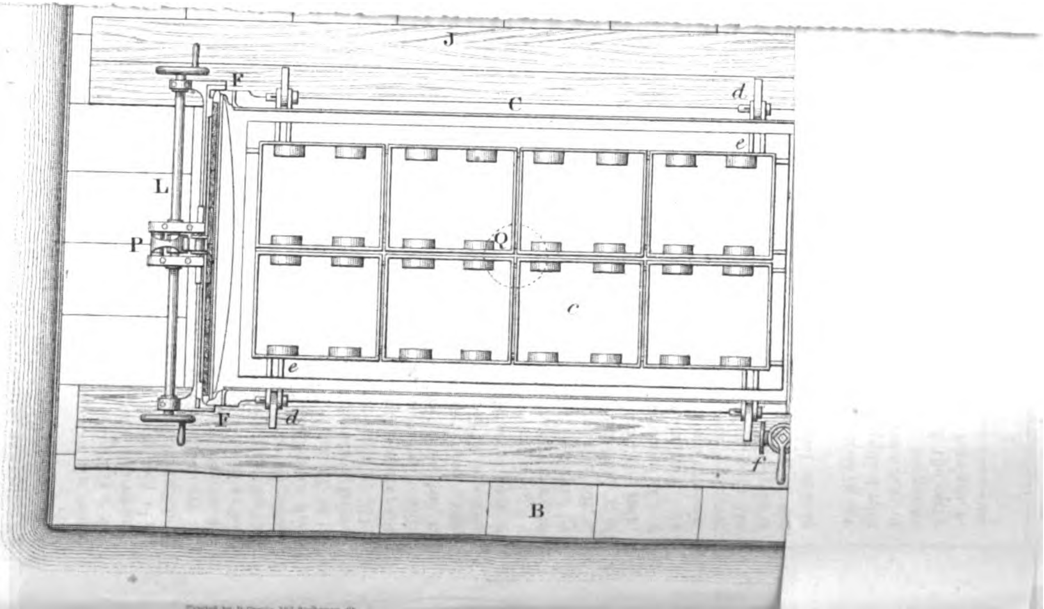
Fig. 1 is a front elevation of the elevating machinery on the water side, the sluice-gate being represented as closed down. Fig. 2 is a corresponding side elevation of the same, as moored alongside the wharf; and fig. 3 is a ground plan complete. Immediately in front, and close up to the wharf or river wall, A, a hollow rectangular air and water-tight receiver, B, made of boiler-plate, is moored or imbedded upon the river's bottom, so as to be immoveable. On the top of this vessel is erected a rectangular, open-topped chamber, C, also of boiler-plate. This chamber, or receiver, is fitted with a front sluice-gate, D, on the river side, for the entrance and exit of the punts, and it is carried up to such a height as may be necessary to carry a water-level of sufficient elevation to float the punts to the level, where the waggons thereon may be run off, on to the pier head. The front end, E, of the chamber, C, is of cast-iron, bolted or riveted on to the edges of the side plates by angle-irons at F F. The lower portion of this end is open, to form the entrance for the punts; and this entrance is guarded by the sluice-gate, D, which is arranged to slide vertically upon suitable plane faces on the interior surface of the end, E. The weight of this gate is counterbalanced by the two weights, G, suspended from chains passing over fixed pulleys, H, supported in brackets carried by the stationary end, E, which chains are finally attached to eyes at I, near the bottom edge of the gate. A platform, J, is carried along the two sides of the chamber, near the top, to carry the attendants for working the apparatus. The raising and lowering of the gate is effected by the two winch handles, K, on opposite ends of the horizontal shaft, L, carried in bearings in the two end brackets, M, bolted to the end, E, of the chamber. This shaft carries a toothed pinion gearing with the rack, N, attached at O, near the bottom of the gate, which may be fixed at any point of its vertical travel by a detent, P, hinged in front of the rack, into the teeth of which it is set to gear when necessary. The bottom receiver, B, is completely closed in, and has no internal communication whatever with the water which surrounds it, and it is in communication with the upper chamber, C, only by the wide pipe, or water-way, Q. This pipe is open at both ends, and extends downwards from the bottom of the chamber, C, to the bottom of the receiver, B, which is recessed at R, to allow of a water-way beneath its edges.

The compressed air-magazine, or large receiver, may be placed in any convenient position alongside the wharf on shore, being supplied with air by a pump, or blowing-engine, driven by a small steam-engine, or any other available power. The air is conducted from the magazine by the pipe, S, terminating in the branch, T, on the top of the vertical pipe, U, opening at its lower end into the top of the receiver, B.

* See *ante* p. 279, Vol. III., P. M. Journal.

WATT'S

PNEUMATIC ELEVATOR.



W. Johnson, Patent Offices,
London, Glasgow & Edinburgh.

The natural level of the river is at x, and when a loaded punt is to be elevated from this level for discharge upon the wharf, it is floated up to the sluice-gate, D, and the latter being elevated for the purpose by the machinery already described, the punt is entered into the chamber, and the sluice is again closed. The stop-valve, Y, on the inlet pipe, is now opened to admit the compressed air to the receiver, B. This receiver is always full of water, except at the time of lifting, and is of sufficient capacity to furnish as much water to the elevating chamber as will raise the fluid level from the natural river level, x, to the height which will float the punt to the level of discharge. When the air pressure is let on to the surface of the water in the receiver, B, the water is displaced, and makes its way upwards through the duct or water-way, Q, into the chamber above. The continued air pressure thus elevates the water-level in the chamber, floating up the punt, W, until it reaches the required height, when the air supply is cut off by the valve, Y, and the lifting action of course ceases. The upper edge of the end of the chamber next the wharf communicates with the latter by an inclined platform, Z, carrying double sets of rails, *a b*, which correspond in guage with similar rails on the surface of the punts. The latter rails carry the earth-waggons, *c c*, when floating, and the waggons, constructed of plate-iron, are made so as to pack close together, with their adjacent edges in contact when on the punts. In raising the earth in waggons on the punt, the axles of the wheels are so placed as to bring the bottoms of the waggons close to the punt-surface, and thus lower the centre of gravity. The particular service for which this plan is adopted, is for receiving and carrying away the mud and earth raised by dredging machinery, as the punt, with its complement of waggons, being passed under the discharge end of the dredger, the whole of the waggons are gradually filled without any inconvenience or loss from mud being dropped either between the waggons, or upon the thick edges, which would occur with the ordinary arrangement of wooden waggons. When the loaded punt has been elevated to the necessary height in the chamber, the hinged detents, *d*, on the upper edge of the chamber, are thrown into gear with the recesses, *e*, on the punt, so as to hold the latter in a fixed position. The loaded waggons are then run off the punt along the rails, *a b*, and down an incline, whereon they are conveyed to the place of discharge. The empty waggons to be sent afloat for a fresh supply of earth from the dredger, are similarly drawn up the incline, and run upon the punt as before; and the detents, *d*, being disengaged, the air-discharge valve, *f*, is opened, when the gravity of the water in the chamber forces out the air originally blown into the receiver, the displaced water falls, and finds its way back through the channel, Q, into the receiver, until the fluid level in the chamber coincides with that of the river, x. The sluice-gate, D, being now open, the punt, with its empty waggons, is floated out.

Mr. Watt proposes to economise the expenditure of compressed air in this apparatus, by working two elevating chambers in connection, upon the principle which we have already explained in reference to his canal-lock apparatus. He also provides for the construction of the receiver and chamber of light boiler-plate for the sake of portability, when the whole machine may be transported from place to place after being made buoyant, by blowing air into the receiver, and excluding water from the elevating chamber.

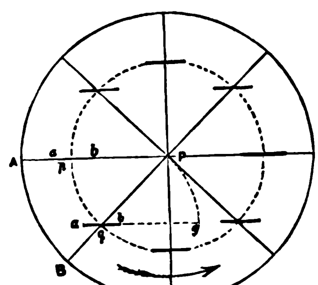
M. FOUCAULT'S PENDULUM EXPERIMENT.

I confess to some little disappointment with the published demonstrations of this interesting experiment, that have fallen under my notice in the journals of this month; not that they are incorrect—for some of them are very beautiful; but none of them appear to me so popular, so readily comprehendable by those possessing a merely elementary knowledge of mathematical science, as the conditions of the question certainly seem to admit.

This opinion is confirmed by remarks and difficulties so commonly and currently expressed, as to induce me to submit a form of explanation, which I have found to be readily enough apprehended by persons in some degree acquainted with mechanical relations.

The phenomenon involves three ideas, and the explanation consists in merely exhibiting their combination. To present the first in a readily intelligible form, let us for the present discard altogether the notion of a pendulum, and direct our attention to the following mechanical arrangement.

Let there be a circular disc, moveable round a vertical axis, P, and at any distance from this centre suppose that a fine pivot, *p*, is inserted parallel to the axis, and therefore vertical to the surface. On this pivot let a small bar be poised at the middle of its length, in the manner of the needle of a common compass, and suppose that it is capable of revolving without friction. Let the direction of this bar or needle coincide with a portion of the radius, A P; and suppose further, that the disc is slowly moved from left to right, in the direction of the arrow, round its axis, through any arc, A B: the pivot will thereby be carried to *q*, and the bar or needle, *a b*—since there is no friction at the pivot on which it is carried, and consequently no reason why one end of it should travel through a greater space than the other—will move parallel to the first position; the extremity, *a*, moving with the same velocity as the pivot moves, will fall behind the point with which it coincided in the first position, and the point, *b*, having likewise the same velocity as the pivot, *p*, necessarily passes through an equal space, and therefore will advance beyond its first position on that line.



Both ends of the needle will therefore describe, in virtue of the "sufficient reason," equal angles with the radius in which the pivot is situated, for they are carried round with equal velocity; and consequently the angle which the needle, at any instant, makes with the radius-line in which the pivot is situated, will be equal to the angle which that line makes, in its new position, with the primary radius, A P. Thus, the angle, *g q* P, of the needle with the radius-line, B P, is equal to the angle, A P B; and the arc, P *g*, drawn from *q*, with radius, *p* P, meeting the prolongation of the needle, is equal to the arc, *p q*, on the disc, with the same radius from P. Now, what is true of any small arc of revolution, is manifestly true of a whole revolution; and since the angles described in any time by the disc and by the needle round their respective axes are equal, they will make their whole revolutions in the same period; and the needle will, therefore, in every position, be parallel to the first position on the axis, A P.

It is, moreover, plain that the length of the circular path apparently described by any point of the needle round the centre, *p*, is equal to the difference of the arcs described in the same time about P, by the pivot, and by that point in the same radius, with which the given point of the needle corresponds when placed in the direction of a diameter of the disc, as shown by the original position on the line, A P. Thus, in a complete revolution of the disc, the length of path described by either extremity of the needle is $= 2\pi \times r$, when r represents the radius of the circle which that end of the needle describes. Now, if the distance of p from the centre of the disc be denoted by R, then the circumference of the circle it describes about P in the same period is $= 2\pi \times \mathrm{R}$, and the length of a circumference of which the radius is greater or less than R by the length of the radius r, is $2\pi(\mathrm{R} \pm r)$; but the difference in length of these circumferences is,

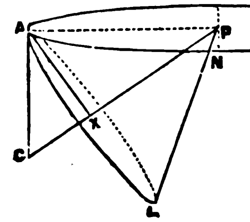
$$2\pi \times \mathrm{R} - 2\pi(\mathrm{R} - r) = 2\pi \times r;$$

or,

$$2\pi(\mathrm{R} + r) - 2\pi \times \mathrm{R} = 2\pi \times r,$$

which is the length of circumference described by the extremity of the needle at a distance, r, from its centre of revolution.

To arrive at a perception of the second idea, let us suppose that the radius, A P, of this disc, is in contact with the slant side, A P, of a right cone, A P L: it is then clear, that there being sufficient friction of the surfaces along the line of contact, if the cone be made to turn on its axis, C P, in the direction indicated by the arrow, through any arc of revolution, it will cause the circumference of the disc to describe an arc of the same absolute length as that described by the base of the cone; realizing, in fact, all the conditions of a pair of angle-wheels in gear.



The angular velocities of these circumferences, viz., those of the cone and disc, are inversely as their lengths, and therefore inversely as the radii of the circles; but the times of revolution are again inversely as the velocities, and, therefore, directly as the radii of the circles. Consequently, if we denote the time of revolution of the disc by T, and that of the revolution of the cone by t, we shall have the following analogy, namely:

$$\mathrm{T} : t :: \mathrm{AP} : \mathrm{AX}.$$

Now, by trigonometrical definition, the ratio $\frac{A X}{A P}$ is the sine of half the angle at the apex of the cone; that is, of the angle A P X; let this angle be called λ: from this analogy we then obtain

$$\frac{T}{t} = \frac{1}{\sin \lambda}; \text{ whence } T = \frac{t}{\sin \lambda}.$$

That is to say, the time of revolution of the cone, divided by the sine of half the angle at its apex, is equal to the time of revolution of the disc.

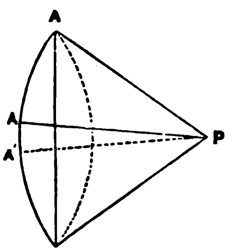
This, then, is the equation of the times of revolution round the respective axes, as for a pair of angle-wheels, to which the arrangement in every way corresponds. Thus, let us suppose, for the sake of simplicity, that the angle λ is 30°; the sine of this angle is $\frac{1}{2}$, and therefore T is equal to 2 *t;* that is to say, the disc, A M, makes one revolution round its vertical axis at P, during the time that the cone makes two revolutions round *its* axis; or a point at A, in the circumference of the disc, will describe a quarter revolution, A to N, in plan, during the time that a corresponding point of the base of the cone passes through half a revolution round its axis, from A to L; and the half revolution from A, through N to M, whilst the cone makes a full revolution; and so on, for any other angles greater or less.

It is then evident, that, in this arrangement, the disc may be regarded as a material development of the tangent surface generated in two revolutions of the cone; and the same reasoning manifestly applies, whatever relation the cone may bear to the disc.

Now, it was formerly shown that a needle poised on a pivot on the revolving disc has necessarily—neglecting friction—the same angular velocity as the disc itself; the equation connecting the motions of the cone and the disc, therefore, applies equally to connect those of the cone and the needle; so that, in the preceding example, a needle thus carried on the revolving disc would, in two revolutions of the cone, make one apparent revolution round the pivot on which it is poised.

This leads to our third idea:—The disc, it has already been observed, may be regarded as the material development of the tangent surface of the cone; but this material development is not an essential condition of the arrangement. It is not, indeed, necessary to suppose that this surface is at all actually developed. If, on the surface of the cone itself, the radius line, A P, of the disc, be drawn from the base to the apex, and this line be observed *vertically* to the conical surface, as it is carried round by the revolution of the cone, it will, at every instant, be moving round a rectangular axis at the apex, exactly as when the surface on which it is drawn was developed in a circular disc round a permanently vertical axis.

To render this, if possible, more distinct, let us return to the preceding figure, and suppose it drawn in plan. A P, Is the radius of the disc, corresponding in length to the slant side of the cone, from the base to the apex. This line is shown in the plane of tangence, and if the cone be made to turn on its axis, through a very small arc of revolution, the extremity, A, of the line, A P, will describe the small arc, A A′, in that plane, round P, as centre. This is the more nearly true, the smaller the angular space generated by the line, A P, is taken; and is absolutely true at the limit of magnitude. Now, according to our supposition, the axis at P remains constantly perpendicular to A P; in the motion of revolution, therefore, we shall have the extremity, A, of this line, always moving circularly to that axis: for what is true at one point of revolution, is necessarily true at every other; and, therefore, true of the whole revolution. To an eye placed at A, on the surface of the cone, and unconscious of any change of vertical position, the motion of translation would necessarily seem to be always round P as a centre, and it would only be by an inverse process of induction, that the real motion of translation could be shown to be round the axis of the cone. This apparent motion round P will consequently make a full revolution, in the same time that the actually developed tangent surface of the cone would make a revolution; that is to say, in the same time that the point, A, describes a path of that length round the axis of the cone, and which, we have already seen, corresponds to more than one revolution. In the example given above, the angular motions are as 1 to 2.

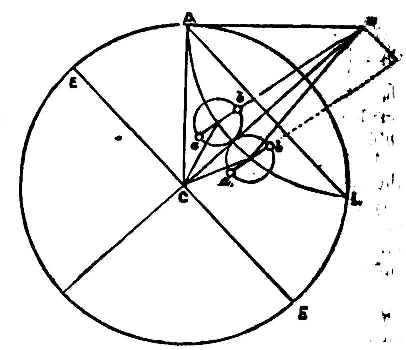


Now, if at A we poise a needle, as before, in the plane of tangence, pointing in the direction of the apex, and we make the cone to turn through a very small portion of its revolution, as in the former supposition, the pivot will be carried through the small arc, A A′; but the needle being affected only by the motion of translation in the plane of tangence, will form with the line, A P, in the new position, A′ P, an angle equal to that subtended by the arc, A A′; and its direction will now be parallel to the line, A′ P; and, consequently, assuming this to be true of every other position, the angular motion of the needle on its axis, and of the line, A P, in the plane of tangence, are equal. But if the angular motion of the needle is thus equal to that of the surface of the cone at every position, and in the same plane, the whole revolution will be performed in the same time as that surface describes *its* ideal revolution round the apex. Now, the times of these revolutions are connected by the equation already deduced for the actually developed tangent surface.

It is scarcely necessary to observe, that this experiment could not be made without some modification, as the needle would be affected by vertical position in moving round the cone. It is easy, however, to see that the difficulty arising from this cause would be obviated by employing a circular disc instead of a needle.

Let us now proceed to apply this reasoning to M. Foucault's experiment. It is readily perceived that, in the circumstances, the needle poised without friction, exactly corresponds to the pendulum; the pivot answers in all respects to the point of suspension, and the needle itself to the line described by the centre of gravity of the pendulum ball. Thus—returning to our first illustration—if, instead of supposing *a b* a needle poised on a pivot, *p*, we assume it to represent the plane of oscillation of a ball suspended by a thread from an arm fixed in any convenient manner on the disc—which we may suppose to be a table carried on a vertical axis, as the experiment is exhibited at the London Polytechnic Institution,—this ball or pendulum being set in motion in the direction of a radius of the disc or table, will tend to move, in virtue of its inertia, everlastingly in the same plane; and supposing that the table is turned slowly and equably round its axis, the point of suspension will be carried forward exactly as the pivot was; and as the vertical line from the point of suspension must ever remain in the plane of oscillation of the pendulum, and as there is no reason why the bob should move differently in the plane of translation on opposite sides of that line, we readily conclude that, like the needle, it will at any instant be found generating a line sensibly, though not indeed absolutely, straight, either in space or in relation to the moving surface of the table. The exact determination of those lines—in space and on the moving surface —involve considerations of a much higher order than any it is here necessary to enter upon. For our present purpose, it is sufficient to regard the path described by the centre of gravity of the bob on the table as a right line—which simply implies, that the motion-velocity of the pendulum is uniform.

For the purpose of combining those ideas in a final explanation of the phenomenon, let us suppose that the full circle in the annexed figure represents the globe of the earth; and A L the plane of the circle of latitude on which the observer happens to be situated at any point, A. From the centre, C, let the radius, C A, be drawn to that point; and perpendicular to it, from the given point, draw A P, till it meets the axis of the earth, produced in P. Then A P is a tangent to the circle of the earth at the given point, A, of the circle of latitude. Now, it has already been shown in the artificial arrangement, that the angular velocity of a point in the circle, of which A L is the diameter, is to that of a point in the circle of which A P is the radius, when the circumferences are connected as driver and follower, inversely as half A L to A P; and the times of revolution are directly as those lines. But we know that the time of revolution of a point in the circle of which A L is the diameter, is accomplished in twenty-four hours; hence, knowing the diameter, it would be easy to determine the time in which a given point in it would generate a path equal in length to the circumference of a circle of which A P is the radius—in other words, the time in which the complete circle of tangent surface would be developed. We do not necessarily know the diameter, but we know the distance from C, the centre of the earth, at which the plane of the circle cuts the axis, and therefore the relation of the angles. It may readily be shown that the angle of



A L, The plane of the circle of latitude.
E E, The equatorial diameter of the earth.
C A, The radius of the earth vertical to the horizon and vertical therefore to the circular table over which the pendulum is suspended by the point, *p*; and
a b, The plane of oscillation of the pendulum projected on the horizontal table; or the line described by the centre of gravity of the ball.

the radius, C A, with the equatorial plane from which the latitude is set off, is equal to the angle which the tangent line, A P, makes with the axis of the earth; and this being assumed, it follows, that the time of revolution of the tangent surface of the cone is given by the equation already found:

$$T = \frac{24 \text{ hours}}{\text{sine of latitude}};$$

or, since the reciprocal of the sine is the cosecant of an angle, we may, with equal propriety, write

$$T = 24 \times \text{cosec. lat.}$$

Supposing, now, that the point of suspension of the pendulum is at p, the plumb-line falling on the circle of latitude will coincide in direction with the radius, C A, and the centre of gravity of the bob must pass through this line in every oscillation. But if a motion be given to the pendulum in any direction, the whole plane of vibration will have a motion of translation exactly corresponding with that of the point, p; and its motion, as in the case of the needle, when referred to the plane of tangence of the cone, is at every instant moving round an axis at P, parallel with the vertical line, C A; and since the direction of motion communicated to the bob is permanent, it will necessarily appear to revolve, in relation to that line, round the point at which the plummet at rest would meet the fixed surface on which the tangent line is drawn, with a velocity inversely as the radius of the base of the cone to the length of its slant side, as before shown.

This conception being fully realized, we are in possession of the whole explanation of the phenomenon.

Supposing that the experiment is referred to Glasgow: the latitude is 55° 51′ 32″, and the sine of this angle, by the trigonometrical tables, is 0·8276524; the time of revolution of the plane of oscillation of the pendulum, supposing that it could be maintained, would therefore be, by our equation,

$$T = \frac{24}{0{\cdot}827652} = 28 \text{ hrs. } 59{\cdot}862 \text{ m.}$$

or 29 hours very nearly. The same result is found by multiplying the cosecant 1·2082367 by 24.

Applying the equation to a situation on the equator, the latitude being 0° and the sine 0, we have $\frac{24}{0}$ = infinity; the apex, P, of the cone is then infinitely distant, and the circle of tangent surface infinitely great; and would consequently occupy an eternity in making a revolution: no motion of the plane of oscillation of the pendulum would therefore be observed in a finite time.

Again, at either pole the latitude is 90°, and the sine of 90° is 1; then $\left(\frac{24}{1} = 24\right)$ hours. The axis of the cone is then infinitely short, and the sides therefore coincide with the base; and the pendulum makes a revolution in the same time that this base makes its revolution, as is sufficiently well shown by our first illustrative figure.

It is further plain, from the relation before pointed out in the case of the needle applied on the plane disc, that the length of arc described in any given interval of time round the centre of apparent motion, by a meridional point in the circumference of a table over which the pendulum is suspended, is equal to the difference of length of the arcs of latitude described in the same time by that point, and by the centre of the table. For whatever the absolute lengths of those arcs are, they are not altered, nor is their difference altered, by development on the tangent surface of the cone; and we have already seen, that in a whole revolution of the conical envelope, the circumference described by a radius of the needle is equal to the difference of two great circles, of which the difference of radii is equal to the radius of the needle. And this being true of a whole revolution of the conical envelope, it is necessarily true of that portion of it generated in a single revolution of the cone; and therefore, when the arcs, referred to the earth's motion, are equal in length to the circles of latitude at the given points.

W. M. Buchanan.

OPENING OF THE MUSEUM OF PRACTICAL GEOLOGY, LONDON.

The year of the Great Exhibition will be a memorable one for London —and where not? According to the purity or foulness of the fountain must be the streams which issue forth, and the purity in this case appears likely to flow with some degree of force, however minute the channel, into all places of all lands. Our pages elsewhere are devoted to a glance at the magnificent museum which the industrial art and science of nations have brought together, at the truly princely suggestion which called forth this form of exertion, and we shall again and again revert to the collection. It is a common saying, that troubles never come alone. It is no less true, but not so ordinarily observed, that great thoughts are not companionless; and nowhere, look where we may, is a great thing solitary. Every tittle at home and abroad receives an impulse, and not so much acts, as is thrust into action, *nolens volens*. A great lever seems unconsciously applied. How? Why? Are queries not necessary to be answered? There it is; it has its work to do, and it does it. While the artist and the manufacturer were inventing and labouring, rough-casting, polishing, and adjusting their myriad forms of strength and beauty, a grander moral power streamed forth into exercise, and has produced results manifold of every hue, from the freshly-trimmed garden and suburban cottage of the moneyed cit, to institutions founded for the instruction, pleasure, and happiness of our children and our children's children, which are destined to last for ever.

From whatever aspect we regard geology, it puts on a form of attractiveness; and—as showing more the worth of the science—of that peculiar kind, the more our minds are informed the more attractive it becomes. The *interesting* facts which minister to first delight are very soon observed to be facts of *importance;* and we are led on from step to step—from mere wild wonder, to careful scrutiny—until we see geology the handmaid of all the sciences, nay, the *sine qua non* upon which each must constitutionally rest.

We are not, in general, fond of arguments founded upon "the present state" of any science; for, to ascertain this correctly, it is obviously necessary that all antecedent and all *future* circumstances must be considered. If we simply compare its present state with its past state, we are tempted to do what many have done—to remain satisfied with the advance made, and we shall have little care or hope of the future. There is, however, a surplus power in the world beyond what is necessary for the tillage of the land and obtaining the abundant harvest, which cannot rest idle. It is here. It must do something. Isolated facts strike this power; others become associated more and more with them; interesting links, chains, and generalizations are observed; a new science comes into existence, with all its long train of heads and hands, which the successive floods of humanity furnish forth for the exigency of the time. When a new science comes into being, it behoves the old and known ones to look about them. Ay, and they begin to look about them, pretty sharply too, when such a stranger comes along. For these strangers ever bring that admirable something with them which they can part with, and yet more firmly retain; and which, by giving, increases their own store. In this respect, these new sciences are among our best monitors. No benevolence is like theirs. And what they thus teach, we generally find their best pupils teach; and go where we may, we are made delighted with the reality which, in all places and in all seasons, we have ourselves *personally* experienced, when the deep lessons of patient thought—the learning obtained by the profoundest abstraction—have been readily communicated to us without fee or reward. A little proof of interest—which is attention—and the desirable thing is done.

Daily do these multitudinous —ologies arrive, and daily do they present, in all forms of majesty and loveliness, new prospects before the seeing eye, and raise the understanding heart to rejoicing. Faster and faster have they latterly come before us; and what are nursery playthings at one moment, are the next analysed and presented in a transmissible shape, as indispensable to all succeeding time. It is not doubtful that these things will characterize the past half of the present century; and, above all, will it point to geology as its culminating honour. Geology is a kind of charter of incorporation of all other sciences. All history has learnt a brilliant lesson from it; and, read aright, humanity has many blessings in store to elevate it in dejection, and stay its footsteps from stumbling. Its generalizations are the means by which such desirable ends are effected. It required only a book wherein we might read—a finely-printed page upon which attention might rest. Thanks to some of the master-minds of our age, the volume is opened for us; and in the Museum of Practical Geology, the British Islands, in this distinguished year, have opened a school, depending for its healthy continuance alone upon individual observation and energy.

The new building is entered from Jermyn Street, and has been erected after designs by Mr. Pennethorne, and does him considerable credit, for the manner in which the difficulties for the especial appropriation of the peculiar contents have been overcome. The façade towards Piccadilly presents a noble piece of comparatively plain and uniform architecture; and, had the economical arrangements of the interior allowed, no doubt it would have been better to have had the entrance from the great thoroughfare of the west end of the metropolis, rather than in the comparatively silent and bye street in which it is placed. On entering, a small flight of stone steps leads to the hall, and immediately beneath the roof-light is displayed a beautiful and elaborate specimen of mosaic pavement,

surrounded by Doric columns, supporting the principal floor, running round the building as an enlarged gallery. Here also are white marble busts of Dr. Hutton and Sir James Hall, Bart., by Mr. Park, and of John Playfair (after Chantrey), and Dr. William Smith, by Mr. Noble. This lower floor is scattered over with different kinds of granite and marble tazzæ, elevated on appropriate pedestals, and glass-cases containing square block specimens, in the rough and polished, of most of the rocks and stones known to the architect, and examples of various cements; and the walls are decorated with many slabs of beautiful green Irish and other marbles.

A double stone staircase, rising over the entrance, murally adorned with tasty specimens of scagliola, leads to the principal floor, in which the mineralogical collection is arranged in side-cases; and large glass table compartments are also devoted to this purpose, as well as to illustrate the different processes in the smelting and manufacture of the precious and more common metals, china and glass, examples of each, in many beautiful forms, abounding. A second gallery contains the very interesting collection of the ancient flora and fauna of the earth, some specimens of which also form objects of great interest in an upper gallery running round the entire building. On the principal floor, and in an adjacent room, is also arranged a series of models of coal and other mines, with the implements used by the miners in working the mines, including different kinds of the Davy or Safety-lamp, and models of water-wheels and steam-engines, blowing-engines and blast-furnaces. Among other objects not unworthy of notice, may be mentioned the processes in the manufacture of gun-barrels, iron-castings, a few very good enamels, ancient and modern china, including the beautiful ware of Wedgwood, of Chelsea, Worcester, and Derby, Roman and Venetian glass, paintings on china, Daguerreotype processes, and carefully prepared electrotypes of flowers, &c., presented by Captain Ibbetson; types for calico and other cotton printing, mineral colours, agates, cameos, imitation gems, and the Ordnance maps geologically coloured. As a crowning advantage to such a collection, it is brilliantly lighted from the ceiling, there being no side lights whatever.

The Great Exhibition has been regarded from many points of view, and many different *perspectives*, if we may be allowed the expression, have been drawn of powers it may tend to awaken into progressing activity. Portions have been pointed out to the educational faculties of the producer and consumer of all kinds of food—food for the body and for the mind, the mere external and the mere internal—in the hope that the glorious trophies of industrial toil now visible by the community of the world, may excite every beholder, by diligent comparison, to observe wherein his any defect may lie, and promote the accomplishment of his designs, whatever they may be, by curing such deficiencies, and pushing on afresh, with renewed determination to overcome all obstacles. There is another way of reflecting upon the Great Collection now before us. Is anything *new* to be struck out from it? We do not ask the question whether any mode of industry may be improved or not, for this has long been answered in the clear affirmative. But whether anything new may be planted and trained up from any seed or germ which it enables us to plant into the soil of human action? We may hereafter revert to this mode of viewing the subject, which the Museum of Geology has suggested. In the meantime, we would simply mention one practical idea which might, probably, with a very little energy, be acted upon, and carried out with a success parallel only with that which, from a passing remark contained in a small work of Sir Henry de la Beche, has become embodied in the splendid hall of science now under his guardianship in Jermyn Street.

We have carefully surveyed the greater portion of the wonders sheltered by the wondrous dome. We have also carefully perused the long catalogue—not the least wonder in itself—of the general contents of the building. Satiated with the countless splendid objects, displaying decorations of the person, poor or rich—of the home, rustic or palatial—and of the city, provincial or metropolitan, we turned our attention awhile to the simpler architectural departments, which, in greater detail, are exhibited in the Museum of Practical Geology, and in which *stone*, in all its varied forms, from sun-dried clay to granite, represents one portion of the materials necessary to form human habitations—but one portion only. There is another natural product, however, as important as is the stone, affecting more immediately economy and comfort, viz., *wood*. Linnæan societies, and Botanical societies, exist in many places in the United Kingdom. These societies, however, almost, if not entirely, as exclusively, direct their attention as did the old Geological Society to purely scientific or rather theoretical objects, and not, as does this new form of geological pursuit, to practical attainments. There is no society for practical botanical purposes throughout the three kingdoms, and we think we are right when we say that none exists elsewhere. The Great Exhibition affords the first opportunity for forming a nucleus of something of this kind. Every one who has in the least generalized what he has beheld in the wide circuit of the World's Fair, will recollect how rich it is in specimens of woods from all parts of the globe, even excluding from present consideration the thousands of exquisitely-wrought articles of decorative furniture and ornament produced by the carpenter and cabinetmaker. Particular countries may and have shown us those particular objects, for the production of which a world-wide-famous knowledge had been otherwise long since imparted. The diamonds of Golconda, and the gold of Peru—the barbaric personal gauds of the half-civilized Oriental—the ivory of Africa, and the malachite of Siberia, adequately display their several forces, and leave little to be desired. As little seems left to be henceforth brought forward with reference to *the woods* of all countries. From all points of the compass, here are concentrated the productions of almost every soil. Perhaps, in this respect, the Exhibition contains as complete a museum as could be, for many years to come, collected. We would have these specimens permanently associated together by *a society of practical botany*, wherein the builder, the carpenter, the cabinetmaker (each at present adopting conventional materials), might be able to select the particular species of wood adapted to his purpose, as the architect, the mason, and the sculptor, may and do daily, with this view, explore and examine the beautiful stores within Sir Henry de la Beche's museum. A very little effort, and the thing is done: it is already more than half done. The things we want are there: we can lay our hands on them—we can, with no difficulty, transport them to a few shelves in some by-corner (so the great British museum was begun). The specimens of woods come from various persons—many private and many public. To advance an object such as we would thus suggest, no doubt all the public proprietors would readily and gratuitously afford every assistance, by permitting the specimens now here to remain in this country. This example would, unquestionably, be followed by most of the individual proprietors: of some, perhaps, purchases would have to be effected, but these, it must be presumed, would be very inexpensive. Scotland and Ireland might do this as well as England, and why not Edinburgh, Glasgow, Dublin, and Belfast? Our provincial seats of manufacture are not so completely smothered in their cottons and machinery, we know, as to afford no example of a practical man, in the proper department, capable of taking up the subject with spirit. A few conversations with some influential and intellectual friends—a little correspondence (equally shared with those friends) with the contributors, whose addresses are all furnished by the catalogue—and, we repeat, the thing is almost done. But we have now laid the suggestion before our readers, and we can only say that, so far as any influence we may possess in forwarding the scheme is concerned, we shall be at all times delighted to promote it to the utmost of our power.

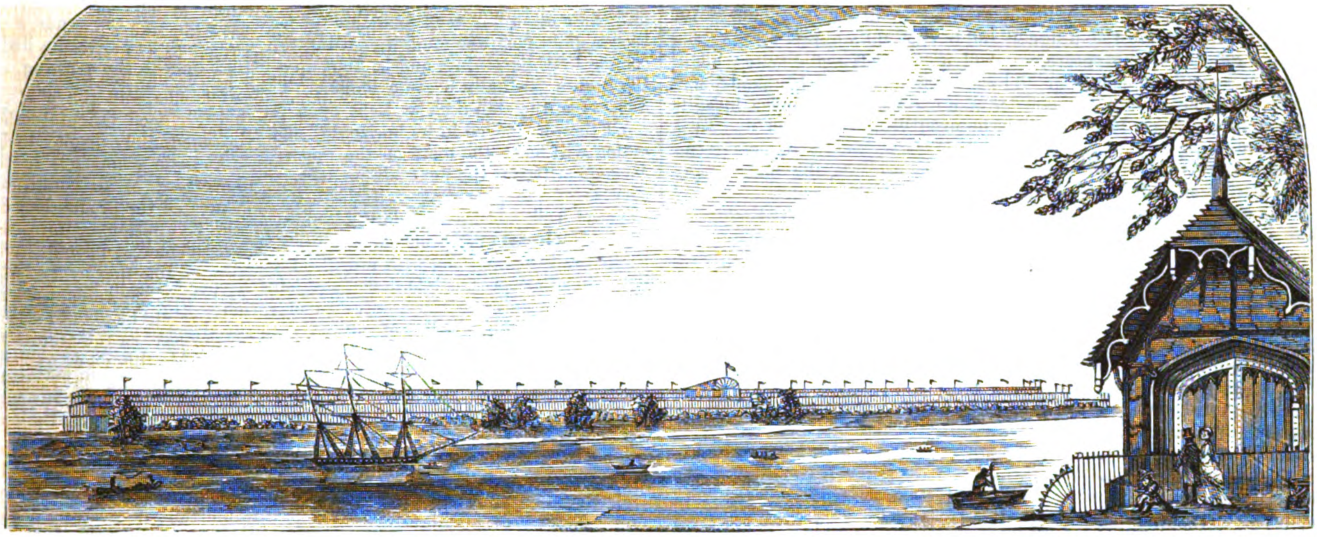
The preceding observations are designedly restricted to the principal class of objects supplied by the vegetable kingdom. It is, however, obvious that the list might be indefinitely extended by many products which contribute so eminently to the comforts of life, and to the use and ornament of mankind. Multitudes of specimens might be obtained from the stores of the Great Exhibition, but they are more within the range of ordinary commerce than are the examples of woods to which we have above more particularly directed the reader's attention.

In conclusion, we advise all our provincial friends, on their intended trip to London to see the Great Exhibition, to make a point also of giving a couple of hours on some Monday, Tuesday, or Wednesday (the only days the building is open), to the interesting and instructive collection in the Museum of Practical Geology.

THE MECHANIC'S LIBRARY.

Astronomy, Six Lectures on, 2d edition, 8vo, 10s. 6d., cloth. G. B. Airy.
Chemistry, Familiar Letters on, 3d edition enlarged, f.c. 6s., cloth. Liebig.
Decorative Art of the Middle Ages, imperial 8vo, 42s., cloth. H. Shaw.
Domestic Architecture in England, 8vo, 21s., cloth. F. H. Turner.
Ecclesiastical Buildings and Ornaments, Principles of, 7s. Drummond.
Electro-Metallurgy: Encyclopædia Metropolitana, Vol. XIV., crown 8vo, 3s. 6d. J. Napier.
Elliptic Integrals, Theory of, 8vo, 7s. 6d., cloth. J. Booth.
Exposition of 1851; or, View of Industry in England, 6s. 6d. C. Babbage.
Field Fortification, Treatise on, 3d edition, plates, 12s.; and with De Laubat's System, 15s., cloth.
Fortification, De Laubat's System of, plates, 3s. 6d. Macaulay.
Geology, Bohn's Scientific Library, 5s., cloth. Richardson.
Great Exhibition, Guide to the, with Plan, 12mo, 1s., bds.
Great Exhibition Prize Essay, 2s. 6d. Rev. H. Whish.
Inventions of the Ancients: "The Pneumatics of Hero of Alexandria," 4to, 12s. 6d., cloth. Woodcroft.
Natural Philosophy and Astronomy, Handbook of, 12s. 6d. Lardner.
Optics, Elementary Treatise on, Part I., 2d edition, 9s. 6d. R. Potter.
Practical Arithmetic, 5th edition, 12mo, 3s. 6d., bds. S. Young.
Railways, Practical Treatise on, crown 8vo, 4s. 6d., cloth. P. Lecount.
Storms, Sailors' Hornbook for, 2d edition, 10s. 6d. H. Piddington.
Water-Bearing Strata of London, 8vo, 8s. 6d., cloth. Preswich.
Water-Colour Drawing Book, oblong 4to, 4s. Rowbotham.

THE GREAT EXHIBITION.



"Sublime Crusade!
Mocking all pageantries of old,
And shaming e'en the witchery of gold,
Call out thy muster-roll,
And with a world-wide soul,
Show ye of what the universe is made!
Let all the nations see
The home of merry England,
Happy, free,
Land of wise love and liberty,
Rejoicing in her strength;
Rejoicing more to view,
Whosoe'er they be,
The Free, and Fair, and True!"—*Anonymous.*

From the north bank of the Serpentine, and beneath the shade of the Royal Humane Society's picturesque boat-house, the eye, stretching across the still waters, enlivened by the miniature majesty of the model frigate, obtains a far-off softened view of the Industrial Palace, under its most peaceful aspect. After wandering through the mazes of the contributions of human ingenuity, and jostling the assembled crowds of pleasure and improvement-seekers, the thinking man will find a stroll through the park, with a glimpse like that which we have faintly pictured above, no bad preparative for a moralising half-hour.

He may here indulge in quiet speculation on the effect which this marvellous school will have upon its millions of eager pupils, and reflect that beneath that airy roof thousands of willing learners are profiting from the teachings of all climes. Turn we, however, to the interior, and, mingling with the gazing visitors, let us continue our tour, and note a few more of its impressions.

Since our last illustrations of its contents, the building has burst into the full bloom of perfection. Empty stalls have been filled up, new decorations added, and foreign states have supplied their gaping deficiencies. The machinery has recovered from the rude shocks of transport and fitting up, and new interest has been added by getting all the backward examples into motion. Messrs. Joyce & Co. of Greenwich have erected one of their oscillating Woolf's engines for driving Mr. Macindoe's mule and a set of looms. This engine, so favourably known for its economy of fuel, has been fully illustrated and described in No. I. of the *Practical Mechanic's Journal.* Messrs. Rennie have a model of their direct-action engines, as fitted to H.M. steamers *Bulldog* and *Samson.* Also a model of a four-cylinder marine engine of 800 horse power; and an improved paddle-wheel suited for deep-sea navigation, together with a model of the disc-engine, as improved by Mr. Bishopp, and fitted for actuating an auxiliary screw-propeller. Mr. M'Naught contributes a large working model of his excellent modification of Woolf's engine* actuating Mr. Coats' recently patented bobbin turning-machine, forming a highly interesting group. Mr. Carrett of Leeds shows his useful contrivance of a steam-pump, four of which are besides put to efficient use in the boiler-house of the Exhibition. The pump in the building is a very favourable example of good plain work, and elegant proportion.

Donisthorpe's circular wool-comb is not more remarkable for the beauty of its action in its separation of the long and short fibres, than for its immense commercial value. The sum of £25,000 is said to have been paid for a very small share in the patent, which promises to accomplish for its projectors what the drawing-frame did for Arkwright, and raise up a new family of millionaires.

* See pages 35 and 152, vol. i. "P. M. Journal."

Mr. Atherton exhibits a new form of marine steam-engine, applicable either to the paddle-wheel or the screw-propeller. The object of this engine, according to the inventor, is to simplify the construction of the marine sway-beam engine, and, as compared with the ordinary construction of side-lever engines, he claims the following advantages:—1. That it occupies less width. 2. That, being in a central position, and connected directly with the piston and cranks, various cross strains are avoided, and it is not so liable to breakage, and the probable extent of damage consequent on any is greatly diminished. 3. The crosshead, crosstail, and various parts are entirely suppressed, and consequently all the parts of the engine are more accessible and more easily cleaned when in operation; in fine, the engine is nearly balanced by means of two air-pumps—one on each side of the main centre—and is therefore less liable than marine engines generally to be brought up in a heavy sea. The steam-slides are so proportioned and adjusted as not to close the exhausting port till after the turn of the stroke, thereby obviating the danger of breakage by water in the cylinder, and suppressing the escape-valves. The expansive gear operates with precision, whatever be the speed of the engine, and supplies self-acting means of regulating the expansive working of the machine.

Messrs. Burton & Eames of Nottingham have sent a "gassing machine" for singeing off the loose fibres of lace and muslins. This curious contrivance attracts considerable attention, from the fact, that in it the fragile fabrics are passed directly through a row of gas flames in order to accomplish the necessary finishing action. It is founded on the universal principle, that all physical agents require a certain time for their effect, so that, although the lace is placed in a situation where, if full time were allowed, it would be totally destroyed,—yet, by so arranging the rate of movement, the fabric is left uninjured, whilst the projecting fibres are carried off. Formerly, the piece was passed over a heated cylinder for this purpose, but modern improvement has introduced the row of gas flames as a much superior agent.

Mr. Black of Edinburgh exhibits a machine for folding printed sheets of paper. When we saw it in action, it was folding pamphlet sheets to an octavo size, for which three several movements are necessary. The sheet is first laid square to a straight edge on a flat table, with its blank central line of fold directly over a narrow slit, through which works a thin folding-knife. As the knife descends, it forces the sheet through the slit, carrying it beneath the upper platform, and producing the first fold. A similar action beneath gives it a second fold at right angles to the first, the blade being set to vibrate in a horizontal plane for the purpose. The third fold is accomplished by a repetition of the first process by a third blade beneath. The sheet is thus carried from one to another of the blades, and is finally delivered in a folded state by a pair of vertical

discharging rollers at the front of the machine. Near this simple piece of mechanism is a machine for forming hemispherical paper-shades for lamps. The process is extremely interesting, and the shades made by it are highly elegant. Flat circular discs of paper, ornamented according to the taste of the designer, and having the aperture for the lamp chimney cut out of the centre, are laid on the edge of a hollow hemisphere, apparently of cast-iron. The interior surface of this hemisphere is fluted or grooved, and the exterior of a corresponding upper block is made to fit it. This block is then brought vertically down upon the paper, squeezing it into the mould, which is heated by steam. After exposure to this heat and pressure for a few seconds, the block is elevated, and the completed shade is removed.

Amongst horological instruments, Mr. John Blaylock, of Carlisle, well known for his manipulative excellence as a machinist, exhibits—"Motion-work for the hour and minute hands of a turret-clock with four dials, and a self-acting and self-regulating apparatus for illuminating dials." The peculiarity of the latter contribution is, that the illuminating gas is not only turned on and off mechanically, but the periods of lighting and extinguishing are varied daily to suit the different lengths of the night all the year round.

Our engravings exhibit, in fig. 1, a front elevation of the regulating apparatus; in fig. 2, a corresponding plan; and, in fig. 3, a side elevation, with the stop-cock removed. The gas is brought by a pipe, on which is the adjustable stop-cock, A, having attached to its plug a bent lever, B, by which it is actuated. The circle, C, represents a worm-wheel, carried on the centre, D, in the bracket, E, to which also the stop-cock is fixed. This wheel is driven at the rate of one revolution per 24 hours, by the worm, F, on a vertical shaft, which conveys the clock movements to the dials. The wheel has attached to it an arm, G, carrying the studs, H J K. The sectors, L M, are toothed—the one externally, the other internally—and revolve with the wheel, C, but are free to move relatively to it on their sockets. The studs, N O, are fixed on the sectors, L M, respectively. The stud, J, in the arm, G, carries two pinions, P Q, and the wheel, R, all fast together, the pinions gearing with the two sectors, and the wheel with the pinion, S. The other stud, K, carries the pinion, S, and star-wheel, T; and by moving the star-wheel, the two studs, N and O, are caused to approach to, or recede from, one another—and from the centre stud, H, fast in the arm, J.

Fig. 3.

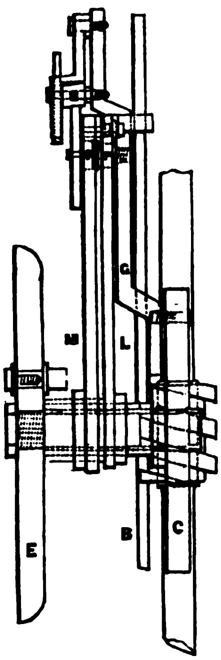
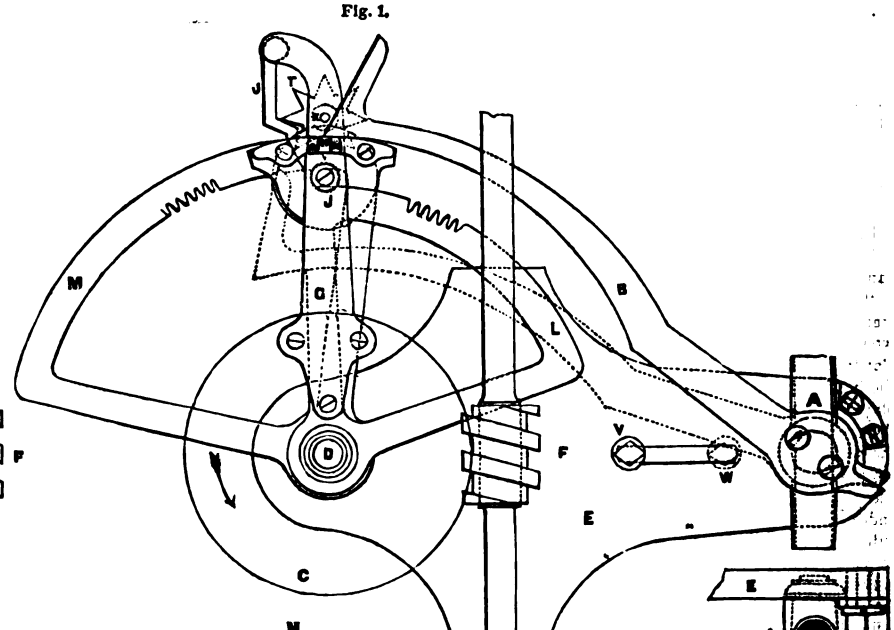


Fig. 1.



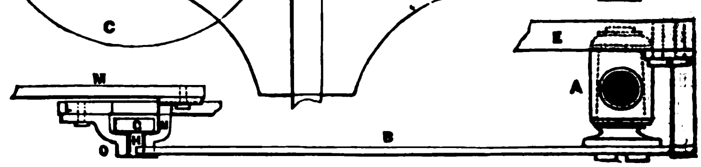


Fig. 2.

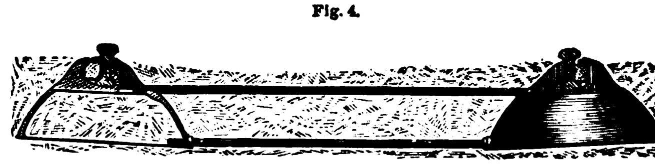
The action is extremely simple: the wheel moves in the direction of the arrow, carrying the appendages we have mentioned with it.

When the lever of the stop-cock is in the position shown by the dotted lines, the gas is cut off, a sufficient current only being left to keep in the flame when the light is again wanted. The wheel, C, in its revolution every twenty-four hours, brings the stud, O, against the end of the lever, B, elevating it to the position shown by the sharp lines, and thus opening the stop-cock for a full supply of gas; this being continued during the time that the three studs require to traverse the circular arc of the lever, which eventually drops over the stud, N, to its former position, shutting off the gas. The outer end of the lever is so constructed that both the opening and closing of the stop-cock shall be gradual, to correspond to the twilight and dawn.

Our figure represents the state of the movement as it would be on Midsummer-day, when the stop-cock will be full open only about six hours—equal to the angular value of the arc and three studs, which are close together. In every revolution, the star-wheel, T, which is held by the detent, U, passes the fixed stud, V, and is moved by it to the extent of one tooth per day. The stud, V, in the position shown, will come in contact with the teeth of the star-wheel on the side next the wheel, C, and the motion will tend to make the two sectors, with the studs, N O, recede daily from the stud, H, causing the lever, B, to be elevated a little sooner in the evening, and be kept up a little longer in the morning, as the nights gradually become longer. This goes on until the shortest day, when the stop-cock is kept open for sixteen hours. The stud, V, must then be moved in its horizontal slot to the position, W, when the action will be on the teeth on the opposite side of the star-wheel, and, consequently, for the next six months, the process will be exactly the reverse of the preceding—all the attention required being the shift of the stud back and forward on the longest and shortest days.

Mr. H. Greaves of Manchester exhibits specimens of his "iron surface-packed railway sleepers, with rails." Fig. 4 represents a front elevation of a pair of sleepers as laid down, the joint sleeper being in vertical section, and the intermediate sleeper in elevation. Fig. 5 is a perspective sketch of a portion of a line of railway with the sleepers uncovered. The points contended for in this plan of permanent way, are—a saving in material of from £200 to £600 per mile, as well as economy in maintenance, and facility of adjustment through packing-holes at the surface, avoiding the trouble of covering and uncovering the sleepers. Besides these advantages, a length of bearing of sixteen inches is given to the joint chairs, so that the joint is as little liable to derangement as any other part of the rail. The external ballast may be broken stones, gravel, or other cheap material; superior ballast only being required for the internal packing, and of this a waggon load, or $3\frac{1}{4}$ cubic yards, will pack

Fig. 4.

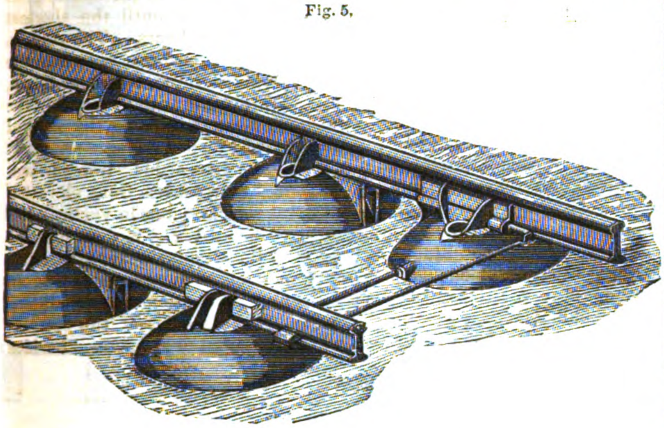


40 yards of sleepers. The joint admits of the easy removal of a faulty sleeper in a few minutes, the compressing plate, or piece of metal between the outer jaw and the wood key, being made loose for the purpose. The strip of plate-iron between the rail and wooden key is to prevent the rails at their junction from lipping and cutting the key. The weight per mile of single line is 104 tons; the cost, with a 70-lb. rail, being taken at £1000.

This system of way has been under trial for a considerable time on the Lancashire and Yorkshire Railway, and of its behaviour here Mr. Torkington speaks in the following terms:—

"As the system of laying chairs upon stone blocks is now generally abandoned, it is not my intention to institute any comparison between

Fig. 5.



the iron sleepers and the stone blocks. I shall therefore endeavour to draw a comparison between the transverse wood sleepers and the iron sleepers. It is very difficult permanently to fasten the chair on the wood sleeper with iron pins. The workmen are instructed to bore a hole with a small auger through the wood sleeper, then drive the pin through the chair into the sleeper; this is generally done by the workman in a very slovenly manner, the timber on the lower side of the sleeper is frequently split or thrust off, seldom leaving more than from three to four inches hold, and if the least movement of the pin takes place upwards, it never can be re-fastened in the same place.

"The wood pins are not liable to the same objections, but, on the contrary, they will, to a certain extent, unite themselves to the fibres of the wood sleeper, and, when once fast, they will most probably remain so. But if the sleeper is not properly packed, and the working of it causes the head of the wooden pin to wear, so that the chair can have a little play, the chair can never afterwards be secured by that pin. Therefore the tendency of the iron pin is to get loose in the wooden sleeper, and of the wooden pin to get loose in the iron chair. Both of these tendencies are obviated by Mr. Greaves' plan, for the chair and sleeper are cast in one piece. Again, it is almost impossible to pack or beat the ballast under the wooden sleeper to a uniform density. In fact, it would require a fine calculation; and to show how a transverse sleeper ought to be packed to fully answer its purpose, it is clear that the ballast ought to be more dense under the rails and each end of the sleeper, than under the centre of the sleeper between the rails. But if it could be theoretically defined, it could not possibly be put into practice. The present method of packing or beating the ballast under the sleeper depends more upon the practice and intelligence of the workman, than upon any scientific rules. In the iron sleepers, the ballast is confined inside the cone, and is made equally dense throughout, by beating through the hole on the top, which can be done by a mere novice, and the whole bearing surface is directly under the rail. Broken stone, burnt shale, or clay, make good ballast; but I have seen good ballast of the above description that would not stand continuous working with beaters. Similar rock from which the bridges have been built has been broken for ballast, and, in a few years afterwards, by working amongst it with picks and beaters, and exposure to the weather, it became a pulpy mass, and was cast off the bank as useless. And stone out of the same bed of rock is now standing in the bridges, and a tunnel as good and sound as ever it was. This would not have been the case with the iron sleepers; for the ballast inside the cone, and underneath it, is protected from the weather, and always dry. When the sleeper requires raising, it is only necessary to lift the cone, and introduce a little fresh ballast; the surrounding ballast need not be disturbed, and no opening out is required to get to the underside of the sleeper.

"The transverse wood road is very liable to get out of line; indeed it has nothing but its own weight, the friction of the bed of the sleepers upon the ballast, and the few inches of ballast there may be at each end of the sleepers, to keep it in line. Hence one of the causes of oscillation we experience when riding in fast trains.

"With the iron sleeper, the ballast inside the cone unites with the ballast under the cone. I had the iron sleepers we were examining bared to the bottom, and no force which the plate-layers, with their ordinary levers, could exert upon them, could move them one atom either to the right hand or the left.

"A road laid upon wooden sleepers will sink, to a greater or less extent, during the time a train is rolling over it, so that the engine has continually to ascend an incline plane, or, what is equivalent, to depress the 'coming' rail, until the ballast is of equal density with that immediately under the driving-wheels; this arises from a combination of the causes named above, together with the changes of the atmosphere, and especially during wet weather. The iron sleepers are not so much affected by the weather, because the ballast under them is isolated from the surrounding ballast, and kept dry, and there is plenty of drainage for the whole of the surrounding ballast, without interfering with the ballast immediately under the sleepers, which is not the case with any description of wood roads. In all wood roads, the joint sleepers are usually most out of order—the joint is evidently the weakest part of the rail, and has the least bearing or support from the chair or sleeper; consequently, nearly all the joint-sleepers we saw were surrounded with water, and worked up and down during the time the trains were passing over them.

"In passing over the iron sleepers with an engine, there was not that rigidity I have felt in going over stone blocks, nor the tremulous motion I experienced whilst going over the transverse sleepers, but a dull, soft, easy motion.

"I am convinced that the power and wear of the engine will be economised. The roads will be kept drier and in better repair, and at less cost, with iron than with wood sleepers, and the engines would ascend inclined planes with less slipping and greater ease than on the transverse sleeper roads."

The extraordinary success of the Exhibition has astonished every one, and none more than its very originators and promoters. Fifty or sixty thousand visitors daily make their appearance, and the pecuniary receipts have become so enormous, that the question of turning the building to permanent account is now argued in a tone which shows something is meant by it. Before its present occupation is at an end, we shall probably have devised some self-supporting system for its retention as a vast educational institution. Borrowing the words of the author of the "Ode on the Great Exhibition," quoted at the head of this paper, we may say, that in it—

"New forms are shaped out of new-found law!
And, after the tempest of the mind,
There, where confusion stormed, we find
That Things that WERE NOT—ARE!
Before the wond'ring eyes
The fair creations rise,
And even seasons new
Come into view,
And all their teeming treasures bring
With this first bud of another spring!
Of iron and glass
Erect the crowning dome,
That centuries as they pass
May see man's first united home,
And all his mighty heart
Playing its happy part
Before the ages still to come!
'Tis well!
Obeyed is the Law!
Children shall tell
Their children's children what they saw!"

RECENT PATENTS.

DRESS FASTENINGS.

J. G. Taylor, *London.—Enrolled June* 11, 1851.

Mr. Taylor's improvements comprehend various modes of obtaining increased security in fastenings of various kinds, the chief feature of the invention being an ingenious adaptation of a screw or helix, one modification of which is shown in our engraving, fig. 1. This figure represents a lady's shawl pin, to the head of which is attached a short helix or spiral, for obtaining greater security of hold in the dress. When the pin is entered into the dress, a slight turn causes the pointed end of the helix to penetrate the fabric, thus becoming screwed in so as to hold the dress more firmly, and, at the same time, prevent the pin from being lost. In this case, the helix is represented as being entirely detached from the metal pin: but the patentee also shows examples of the same principle, wherein a screw thread is cut upon the pin, or a portion of the pin itself

is made to answer as the helix, either at the head or centre of the pin. It is obvious that the spiral is capable of application in a great variety of ways, so as to afford complete security by very simple means. Mr. Taylor also proposes to apply it to common pins, and with still greater effect to nails or joiners' pins.

Fig. 1.

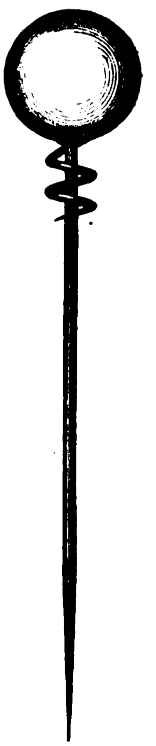


Fig. 2 shows a plan and side view of a stud or button, fitted with a self-piercing coil or volute, A. This coil is on the under side of the button, to which it is attached by a short central stud or pillar. It is attached by turning the pillar round, as described in reference to the pin, and is applicable for holding papers, and for other similar purposes. Another form of fastening is for a "hat-holder." This little apparatus, which may be carried in the pocket, is simply a wire, hooked at one end for hanging up, and having a short limb hinged to it, bent at its lower end. The hat is proposed to be made with a small eyelet hole in the rim, so that the bent end of the limb may be passed through the hole, when it is held down upon the wire to secure the hat by a sliding ring.

Fig. 3 is an example of a novel kind of buckle or connector for various purposes. The portion, A A, of the buckle, D, is passed from behind through the opening, E G, in the buckle, B. This makes a very simple and secure fastening, for the entered portion of the buckle, D, being made rather larger than the slot in its corresponding buckle, their separation is impossible until one of the two is inclined to one side. The openings or indentations, C C, are for facilitating the junction or separation of the buckle. Mr. Taylor proposes several other minor ingenuities in the way of spring connections, and concludes his specification with a description of a process of manufacturing ornaments from horn, hoof, or shell. The material to be treated is first heated until it is softened, when it is placed in heated steel dies cut with the required design. After removal from the dies, the articles are polished in the usual way. By this mode he proposes to make brooches, beads, chains, and other articles, having an appearance and polish equal to jet.

Fig. 2.

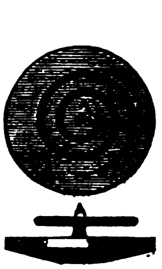
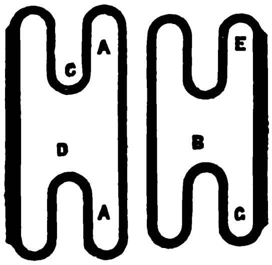


Fig. 3.

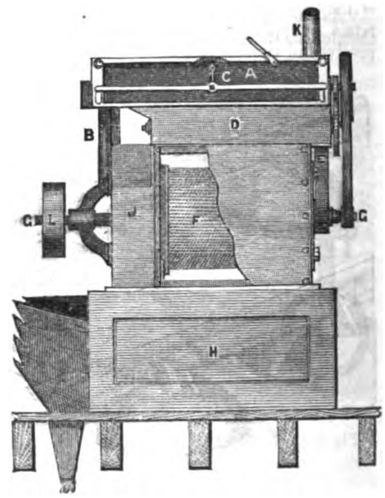


WHEAT SCREENING AND CLEANING MACHINE.

JOEL SPILLER, Esq., *Battersea.—Enrolled July* 29, 1850.

Our engraving exhibits a complete elevation of Mr. Spiller's screener, with a portion of the case removed, to show the interior. A, Is a separator or screen, composed of revolving rollers placed parallel to one another, and just so far apart as to allow the grain to pass between them, while all extraneous matter larger than the grain is carried to their ends, from whence it passes off through the spout, B. C, Is a regulating arm, by which the spaces between the rollers may be simultaneously adjusted so as to suit different sizes of grain. D, Is a box containing a creeper screw for carrying forward the screened grain into the pipe, E. F, Is a cylinder formed of sheet steel, and perforated so as to present projecting edges inside for the grain to strike against. The spindle, G, has several serrated blades attached to it, which revolve at a high speed in F. H, Refuse-box; I, delivery-spout; J, case containing a fan attached to the main spindle; K, the feed-trunk; L, the driving-pulley, which, with an ordinary strap in connection with the motive power, puts the whole machine in motion.

The wheat to be cleaned is let into the machine by the trunk, K, and is first screened through the separator, A, in which the spaces between the rollers correspond to the slits between the wires of an ordinary sieve; but with this important difference, that in one case the wires are stationary, in the other the rollers continually revolve in the same direction, so that the sides of every slit move in contrary directions—the one up, the other down. This causes the grains immediately over the slits to turn and present themselves most favourably for passing through; and hence it is, this separator will not only screen much closer, but will do twelve times more work than any other in use with the same amount of surface, and this without the possibility of ever choking.



The other important and equally novel feature in this separator is, the adjustability as to guage. By one motion of the hand (even when the machine is in action), all the rollers may be opened or closed simultaneously; thus giving the power of screening, by one separator, every size and description of grain to the greatest advantage.

The grain having passed through the separator, falls into the box, D; and by the creeper screw inside, and flat pipe, E, is conducted into one end of the perforated cylinder, F, where it is equally distributed by the centrifugal force imparted to it by radial ribs on the face of a disc revolving with the main spindle; the grain, rebounding from the cylinder, is continually struck by the serrated blades before described, in its passage through the cylinder, and thus thoroughly scoured; the clods, smut balls, and the outer pellicle of the garlic seeds, are so broken that they, together with small seeds, stones, mice-droppings, dust, &c., are instantly urged by the motion of the serrated blades, and the blast they cause, through the oblong perforations of the cylinder into the box, H.

The grain is carried forward to the other end of the cylinder by the serrated blades being placed at an angle with its axis, and then falls through a current of air caused by the fan in J, to clear it of any remaining chaff or dust, and passes through the floor by the spout, I, thoroughly cleaned.

Besides superior efficiency, this machine requires less power to work it than the ordinary ones, occupies less space, and is but little liable to derangement; hence, to the practical miller, it will be found a highly valuable acquisition, more particularly when engaged in the manufacture of flour from foul foreign wheats.

REGISTERED DESIGNS.

SELF-CLEANSING DIAMOND-TOOTHED WHEEL GRUBBER.

Registered for MR. JOHN TENNANT, *Shields, Monkton, Ayrshire.*

This remarkably effective implement comprehends the several points of improvement of—a superior grubbing action, for disintegrating and cleansing land—simplicity and strength of parts—the retention of the lubricating oil upon the spindle of the adjustable pilot wheel—and the prevention of the entry of sand into the wheel bearings.

The four figures of our engravings exhibit, in fig. 1, a longitudinal elevation of the grubber; fig. 2, a corresponding plan; fig. 3, a transverse section of one of the tines, or teeth, on a larger scale; and fig. 4, a longitudinal section of the bearing of the pilot wheel spindle, also on a larger scale. A, Is the main longitudinal beam, morticed at B C, to receive the two tine bars, or transverse trams, D E. Four of these teeth, F, are carried upon these two bars, the heads of the teeth being morticed for adjustment upon the bars, their positions being fixed by set screws. A fifth tooth, G, is attached by a mortice and pin to the main beam, A, in front of the other four. The front portion of the beam is curved upwards, in order to give greater height for the adjustment of the vertical position of the wheel, H, the spindle of which is carried in the lower end of the forked bar, J, morticed into the extreme front end of the beam. The spindle of the wheel is tubular, the bolt, K, being passed through it with a tight fit, to hold it firm without revolving. At each

end of the tubular spindle is a cylindrical cup, or chamber, L L; one being in one piece with the spindle, whilst the other is loose, to allow of adjustment. The boss of the wheel is turned down on each side, and the edges of the two chambers fit over these turned portions, spaces being left to retain a supply of oil for the constant lubrication of the spindle, as it revolves in the boss of the wheel.

Fig. 1.

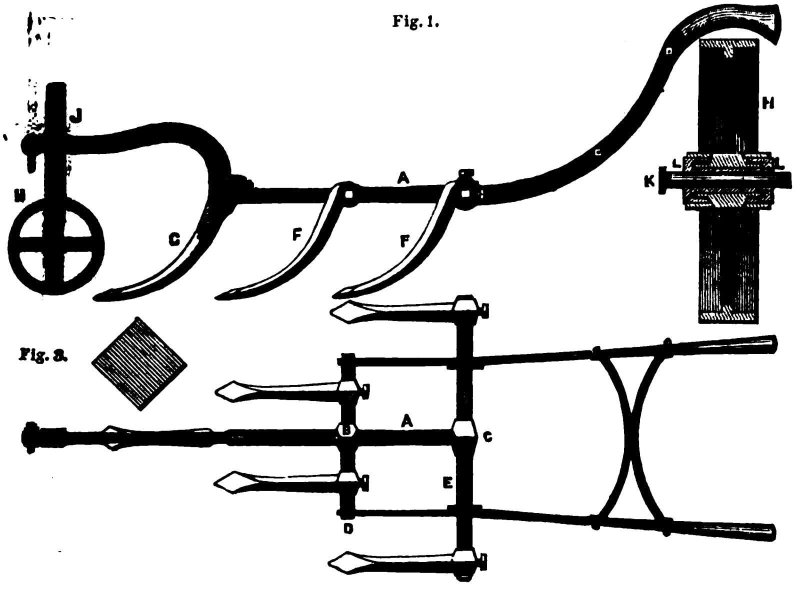


Fig. 3.

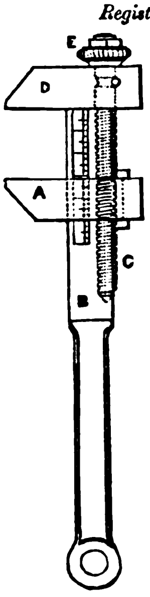
Fig. 2.

For the further security of the spindle, and the prevention of the entrance of sand, two ferrules are passed tight over the chambers, and fitted upon two slight shoulders, turned upon the wheel boss. This mode of construction insures great strength, whilst the frictional surfaces are kept well secured from sand. The angular action of the diamond, or square section of the teeth, as in the enlarged section, fig. 3, is most effective in disintegrating the clods of earth, and this form, at the same time, allows the teeth to pass easily through the ground.

Amongst our correspondence of the present month will be found an interesting letter from Mr. Tennant, in which he introduces his new grubber in connection with his improved agricultural system.

ADJUSTABLE SCREW-KEY.

Registered for MR. G. YOUNG, *Machinist, Glasgow.*



Simplicity and efficiency are both combined in Mr. Young's screw-key in very favourable proportions. The actuating nut is conveniently placed, whilst the screw is secured from chance injury by being recessed into the lever.

Our engraving exhibits a side elevation of the key, one-fourth the actual size. A, Is the moveable jaw, morticed to slide on the square portion of the lever, B, which is grooved out at the back for the reception of the screw, C. This screw revolves at one end, in a centre formed in the end of its groove in the lever, whilst at the other it works in a bearing in the fixed jaw, D. Its actuating milled head, E, projects beyond this jaw, the screw being deprived of any longitudinal motion by a small pin passed through the jaw transversely, and projecting into a ring groove turned in the spindle. The motion of the screw is communicated to the jaw, A, by a half nut, having side or end flanges fitting to the sides of the jaw, so that, by turning the milled head, E, the jaws may be expanded or closed at pleasure.

The key has an extremely neat appearance, whilst nothing is lost in point of strength.

The convenience and great saving of time arising from the use of adjustable keys are so obvious, that it is unnecessary to urge anything further in favour of a neat arrangement like this.

1-4th.

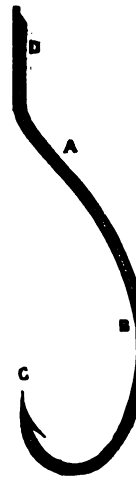
CENTRIPETAL FISH-HOOK.

Registered for MESSRS. S. COCKER & SON, *Porter Steel Works, Sheffield.*

This apparently fantastic name has been given by Messrs. Cocker to a most ingeniously-improved modification of the ordinary fish-hook. The object of the new form is to prevent the objectionable swerving action to which the common hook is liable when suspended in the water; whilst, at the same time, increased strength is secured.

Our illustration represents a bait-hook of large size, made on the "centripetal" principle. It is shown in the position which it would assume when suspended for use.

Fig. 4.



The shank, A B, instead of coming straight down, with the terminal bend all on one side, is curved back from the side next the point, C, so as to bring the latter into a perpendicular line with the line of suspension, D. By the adoption of this shape, any strain coming upon the hook's point is brought directly beneath the line of the shank, being the most favourable action, as well for the steadiness of the hook, as for its strength.

We have alluded to the peculiarity of the name which has been given to the invention, which, at the first glance, conveys the idea of an over-stretched eccentricity of choice. In reality, the word "centripetal," whilst it is a pointedly distinguishing title, is a scientifically correct one, as will be observed by any one who examines the effect of the bend. This is very easily tested by suspending a little weight from the point of the hook, and watching its behaviour under trial, as compared with that of the common hook under similar circumstances.

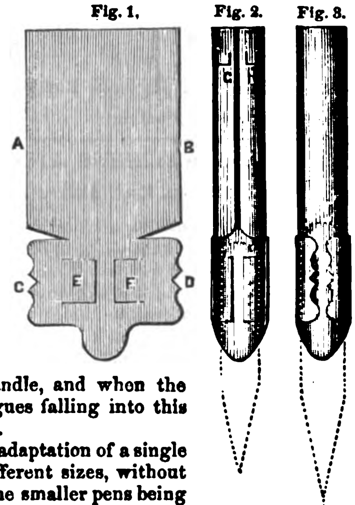
The improvement promises to be so important, that we may shortly look for its universal adoption by fish-hook makers, who, we believe, may obtain licenses for its adoption from the proprietors.

PEN-HOLDER.

Registered for MESSRS. RUDHALL & CO., *Birmingham.*

Our illustrative figures represent Messrs. Rudhall's pen-holder in its progressive and finished state. Fig. 1 is a plan of the blank, as struck out of flat metal, previous to rolling up into the finished form, as shown in the front elevation, fig. 2, and back view, fig. 3. In forming the blank into a cylinder, the two edges, A B, are brought nearly into contact, as seen in fig. 2, the parts, C D, being bent back to the position shown in fig. 3, as flaps. The tongues formed by the incisions, E F, are slightly raised in the interior of the cylinder from the plane in which the surrounding parts are situated. The holder is attached to the usual wooden handle by the tongues, G H, depressed below the plane of the rest of the metal. A ring groove is made in the handle, and when the holder is forced on to it, the tongues falling into this groove afford a steady connection.

Fig. 1. Fig. 2. Fig. 3.



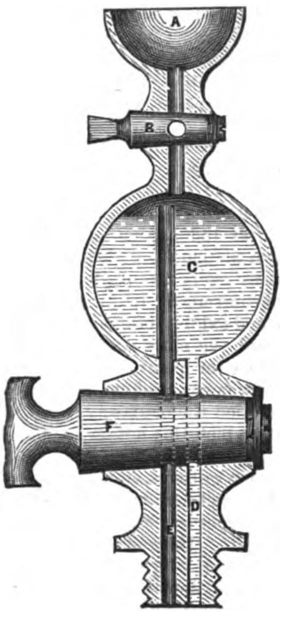
The object of the design is the adaptation of a single pen-holder for holding pens of different sizes, without altering the figure of the pens—the smaller pens being held between the tongues, E F, on the interior of the cylinder, and the larger ones between the flaps, C D, on the exterior of the cylinder, as indicated by the dotted lines in figs. 2 and 3. In addition to this novel feature, the groove and catches, G H, afford a simple and

ready means of connecting the holder to the handle or stem. If two pens are introduced at the same time, a reservoir for ink is formed, thus serving the purpose of a fountain pen.

EQUILIBRIUM LUBRICATOR.

Registered for MR. W. C. MORTON, *Engineer, Burnham, Bucks.*

This lubricator has been contrived for the more effective application of the oil to machinery, where the oil reservoir is subjected to steam pressure; as, for example, in lubricating a steam-engine cylinder. Our engraving represents a vertical longitudinal section of the lubricator, as adapted for such a purpose.



Half-size.

The lubricator is fed by the supplying cup, A, the passage from which is regulated by the stop-cock, B, here shown as closed. From this cup the oil flows directly into the spherical reservoir, C, shown in the figure as nearly filled. D, Is the channel conducting the oil from the bottom of this reservoir, through the lower branch or pedestal of the lubricator, to the point of lubrication. This lower part is made of sufficient diameter to admit of a second and parallel passage, E, continued upwards within the reservoir, so that its open top stands nearly level with the top of the reservoir, and above the level of the contained oil. Both passages are governed by the stop-cock, F, formed with a double bore to correspond to them.

We have supposed the apparatus to be fitted on to a cylinder cover, to supply oil to the piston in the interior. When oil is to be fed into the reservoir, it is poured into the cup, A; and the stop-cock, B, being opened, the fluid descends to the reservoir, C, its stop-cock being closed. The position of the stop-cocks is then reversed, the upper one being closed and the lower one opened. The result of this movement is, that as both the passages, D E, open into the steam-cylinder, steam immediately rushes up the passage, E, and, pressing on the surface of the oil in the reservoir, balances the upward steam pressure by the oil passage, D. In this way an equilibrium is established, and the oil descends simply by its own gravity, and finds its way into the cylinder. With very little additional work, this lubricator is a vast improvement upon the ordinary oil-cup.

ROOFING TILE.

Registered for CAPT. H. G. R. ROBINSON, *Castlewarden, Naas, Ireland.*

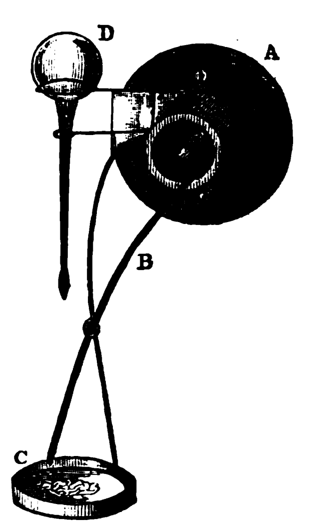
The improvement contemplated in this form of tile is great lightness, and consequent economy in the construction of roofs. The tile is a flat square, with an overlap on two sides of only about an inch, instead of about a third of the entire surface, as in the old form. A roof of them is bound together by the raised ledges or overlaps, under and over, the tile resting by a button or knot on the roofing-lath beneath. Each tile weighs something less than 5 lbs., and about 110 of them will cover 100 superficial feet, weighing less than 5 cwt., or 1 cwt. less than either Countess or Duchess slating, and 4 cwt. lighter than any other form of tile. Hence arises a considerable saving in the timber of roofs so covered, whilst they can be put on at a cost of about 1s. 6d. per square, the tiles themselves costing 12s. or 14s. per 100. The form of overlap makes an excellent water-tight junction, and the flat surface which a roof of this kind presents, gives a very light and elegant effect. In the Great Exhibition is a wooden model of a roof of this kind, which points out very clearly the advantages of the plan. The invention was lately exhibited by Dr. Bagot at a meeting of the Royal Dublin Agricultural Society, and was received with marked approval, as being excellently adapted for cattle-sheds and other agricultural buildings. In the lightness of his timbers, and cheapness of the tile itself, the farmer will obviously find substantial reasons for the introduction of Captain Robinson's invention. But as beauty of appearance is a prominent feature of the tile, it will have a fair claim to the attention of the builder for many other purposes.

FIRE AND BURGLARY ALARUM.

Registered for ISHAM BAGGS, and J. W. GILES, *Aldersgate Street, London.*

Borrowing a name from the Greeks, the inventors of the "fire and burglary alarum," have introduced it to public notice as the "pyracoust." Our engravings represent both species of alarum. Fig. 1 is the fire-apparatus: A, is a bracket, having attached to it an open case, to the bottom of which is connected a small maroon, communicating with the conductor, B. The end of this conductor passes through a loop in the small wire, and projects over the dish, C, containing a combustible compound. Immediately over this dish is a glass vessel, D, with its small end hanging downwards, and containing a few drops of acid, retained in the vessel by a wax plug.

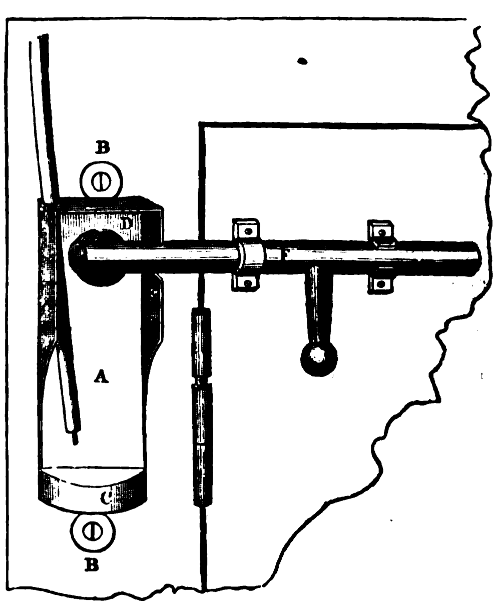
Fig. 1.



The apparatus, so fitted, may remain intact and in good order for years, whilst, like a watchful servant, it will at once exercise its proper functions when its services are called for. Should a fire break out in the room where it is placed, the hot air ascending to the ceiling, where the instrument is to be placed, will at once bring the alarum into action. Whenever the temperature exceeds 150°, which experiment has shown will take place almost immediately, and almost before the lower stratum of air has become warm, the wax-plug in the tube of the vessel, D, becomes softened, and allows the contained liquid to flow down, and fall upon the combustible matter in the dish, C; ignition follows instantly, and in this way the conductor and maroon are fired, producing a loud detonation, sufficient to awake the slumbering inmates of the house.

Fig. 2 is the burglary alarum; a modification of the first plan by extending the pyrotechnic conductor downwards, and connecting its extremity with an apparatus permanently attached to the door of the room. The figure represents one of the upper corners of a door, to the frame of which is attached a brass case, A, by screws, B B. The combustible mixture is contained in the dish, C, and the igniting acid is in the glass-bulb, D, cemented to the back of the case. The bolt, F, on the door, at the hinge side, is shot back in the day time, when the protector is not required, but at night it is drawn forward, and locked in the position delineated in our engraving. When so arranged, any attempt to force the door will break the glass-bulb, and detonation is thus caused in the manner before described. Both arrangements are devoid of all complication, whilst they possess great certainty of action.

Fig. 2.



CORRESPONDENCE.

SOME "NOTIONS."

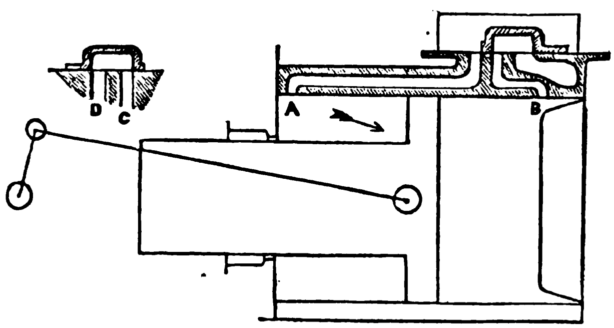
I have only just received the *Journal* from January last, and I will, with your permission, make a few remarks on some of the interesting matters contained in it, though, from not having read it for six months, I am rather behind with your readers.

Mr. Carrett's steam-pump supplies a want long felt, by introducing a pump that can be driven at a high speed, without noise and damage to pipes and valves. His pump is what in the marine engine-room is generally called a "donkey;" and it is a very common vice of those which have the pump directly attached to the piston, that they "won't go" above a certain speed, from the water not being able to fill the pump-barrel fast enough, and the plunger then strikes hard upon the water, without doing more than a little work. The result, a scarcity of water in the boiler, is sometimes amusingly attributed to the high pressure of the steam at the time, which will not let the water come in.

You mention in the "Monthly Notes," that the *Banshee* went lately on trial at the rate of 16·077 miles. This is no great speed for such a vessel, until it is mentioned that, in order to fit her better for general service and long voyages, she has been deprived of half her boilers. With her full power, as formerly employed, she has reached a speed of twenty statute miles.

A good deal of attention seems to have been attracted by Mr. Sims' expansion engine, and very justly. Like others, I had my ideas about it when it appeared, and would have sent them to you but for press of other matters. It occurred to me at the time, that a very considerable simplification of the machine might be made by adopting the trunk engine, with a slide valve exactly similar to that proposed in your May number, by Mr. Alexander Morton. A diagram will suffice to explain

Fig. 2. Fig. 1.



my arrangement, upon which I am now designing an engine for a friend. The engine is represented, in fig. 1, as taking steam from the boiler by the port, A, while the steam which has been expended in the last stroke is escaping by the exhaust port. The slide being moved to the other end of its travel, the steam from the side, A, of the piston will be transferred to the opposite side, and expanded, as in Mr. Sims' engine. One useful feature in this valve is, that the only steam wasted by the ports is that contained in the port, B, which may be made as short as the distance between the slide face and cylinder will allow.

I may state, without any desire to interfere with Mr. Morton's claim to the invention of this valve, that it first occurred to me five years ago, when Nasmyth's steam-hammers were being put up in the place I was in. I was restrained from showing the plan to Mr. Nasmyth, by what I must call *mauvaise honte*—(there is no English equivalent)—for I am certain now that he is too liberal a philosopher to despise a suggestion, coming from a quarter however humble. If you imagine the engine I have sketched turned up on end, the trunk-end down, and a piston-rod and hammer substituted for the trunk, you will have a correct idea of my scheme. The effect of the arrangement of ports and valve will then be to completely equalize the pressure on both sides of the piston, and thus increase the force of the blow in the down-stroke. In Nasmyth's arrangement, represented in fig. 2, the port, C, leads to the cylinder under the piston, D, to the atmosphere, with a branch to the upper side of piston, thus partly equalizing the pressure in the down-stroke; but still the greater part of the steam goes out direct into the air.

I do not consider the invention of such a valve as this worth claiming as meritorious, as it is so simple that any one would hit upon it on the occasion arising. I send it to you as a slight improvement on the steam-hammer, and on Sims' engine, which I would never have forgotten, as the first Woolf engine with a single cylinder, or, more correctly, a single slide-valve.

Lisbon, June, 1851. ALADDIN.

THE ROTATION OF THE EARTH.

In my former letter I stated the great fact of Foucault's discovery, viz., that every vibrating pendulum in our latitudes tends continually to change the direction of its motion as it continues to oscillate, causing, without any apparent reason, and contrary to received notions, the plane of oscillation to turn round the vertical axis of suspension, and that the true cause of this rotatory movement is ascribed by Foucault to the rotation of the earth in the opposite direction. But the question, in this view, which naturally arises, and which every one asks, is, how can the pendulum possibly indicate and render apparent to us a motion of which all nature is insensible? We ourselves participate in this motion, along with every other object on the earth's surface, and yet would never have discovered it but by looking beyond the earth into the celestial sphere; and there, no doubt, we perceive a general motion in the sun, moon, and stars, which reason and sound philosophy, after the lapse of ages, have taught and convinced us arises from our own motion, along with that of the earth, in the opposite direction, as it turns every twenty-four hours round its axis. But that any object, or simple movement, within the earth itself, should become sensible to this motion, and exhibit its effects, is quite a new idea, and appears truly surprising—and the more unaccountable, seeing the pendulum ball, the cord, the fixture or point of suspension, are all carried along by the same general movement, and cannot, therefore, one would think, betray any relative motion the one away from the other. Hence arises the natural incredulity which this notion is apt at first to create.

But all doubts will vanish if we attend to one or two simple considerations; and, first of all, the great law of nature and foundation of mechanics—that bodies once set in motion tend to perpetuate that motion, and this in the same direction in which it is begun. Inert matter has no power in itself to stop, or even relax, the motion originally impressed upon it, or to alter its direction in the slightest degree. Any change coming over the body in this respect must come from without, from some external cause which is either known, or becomes the subject of inquiry. Hence a pendulum set in motion, for instance, so as to oscillate in the plane of the meridian, has no power in itself to change its direction, but would continue to move from north to south, and back again from south to north, until affected by some external cause of disturbance. Imagine, now, to simplify the case, such a pendulum placed over the pole itself, where, if not oscillating, it can have no motion at all, excepting a rotatory motion round its own centre; the ball, the cord, and the point of suspension, all turning round the common axis passing through their centres, and thus coinciding with the axis of the earth. In that case, if we conceive the pendulum set in motion and oscillating in the plane of the meridian, and the ball pointing out on the floor beneath a line due north and south, what, then, ought the effect to be? That the ball will continue to oscillate for a considerable time is certain; but will there be any change in the direction of its oscillation? If the ball were to follow the great law of inertia, it would continue to move in the same direction as at first—the plane of oscillation would stand perfectly still, as well as the line marked out on the floor by the ball. But not so the floor itself, and the meridian line marked out by the ball at first. The floor and all around it, participating in the earth's rotation, would turn round a point directly under the point of suspension, and carry with it the meridian line away from the line of vibration of the ball, and cause in the latter an apparent deviation in the opposite direction. But this appears very difficult to conceive, when we think of the point of suspension itself turning with the earth. Will this not have the effect of an external disturbing cause turning the cord along with it, and causing the ball to follow, and so carrying the plane of vibration round, whereby no relative motion or deviation from the meridian could occur? Here is the delusion into which the mind naturally falls; but a little reflection will dispel it. That it is a delusion, however, may be proved by a very simple experiment. Take a small ball or plummet, hang it by a thread, and hold this thread between the finger and thumb as the point of suspension, resting the hand on the edge of the table to steady it, then give the ball its pendulous motion, and it will be found to oscillate steadily in one direction. If, while thus oscillating, we give the thread a twist between the finger and thumb, so as to communicate a rotatory motion to it and to the ball, which will follow, it will now be found, that in spite of this rotatory motion in the cord and ball, the direction of the plane of oscillation remains immoveable. Or again, if we take a square frame of any kind, like the frame of a picture, suspend

the cord and plummet from the middle of the top bar, and put a pin directly below it through the middle of the bottom bar, and into the table, so that the frame can be made to turn round this point vertically, then set the pendulum in motion in the direction of the frame, turn the whole slowly round, carrying the ball and cord, of course, in the same rotatory motion, and yet it will be found that the plane of oscillation remains immoveable—the frame can be turned round the whole circle, the plane of the frame moving away from the plane of oscillation, and turning round it. This, though simple, is a very remarkable experiment, and gives the key to the whole subject, the frame representing the earth, and the cord and plummet a pendulum oscillating at the pole: and when we now reflect on the matter, it must be evident that it cannot be otherwise; for though the pendulum at the pole may have a rotatory motion, this leaves its centre of gravity in perfect rest. It has no progressive motion whatever; and therefore, when a new motion is communicated to it of a progressive kind, it acts upon the ball exactly as if it were at rest, that is, with its full effect. The rotary motion of the ball can have no effect on the progressive motion northwards or southwards, any more than the rotation of the earth has any effect on its progressive motion round the sun. The plane of oscillation, therefore, must remain immoveable at the pole, while the earth, with the meridian line, will revolve round it and round the whole compass exactly in twenty-four hours.*

Such being the simple effect at the poles, we might now consider the effect on the different latitudes, which must be reserved for another paper. Meantime, I may mention a view taken of the subject by Foucault, which places it in a still clearer light. "The facts," says he, referring to his experiments, "agree perfectly with the results announced by Poisson in a very remarkable memoir read before the Academy, 13th November, 1837, on the motion of projectiles in connection with the diurnal motion of the earth;" and in which Poisson shows, by calculation, that, under our latitudes, projectiles discharged towards any point of the horizon are subject to a deviation constantly towards the right of the observer placed at the point of discharge, and looking in the direction of it. "It appears to me," says Foucault, "that the motion of the pendulum resembles a projectile, which deviates towards the right as it recedes from the observer, and necessarily deviates in the opposite direction in returning to its point of departure, which leads to a progressive displacement of the plane of oscillation, and shows the direction of it. The pendulum, however, gives the advantage of accumulating these effects, and transferring them from the dominion of theory to that of observation."

These observations of Poisson are no doubt remarkable, and show the near approach he had made to Foucault's discovery, but yet stopped, as it were, on the verge of it; and what is equally remarkable, refers to the pendulum in another passage, but considers the deviation would be too minute to be detected by observation. Taking his view of the subject, however, and supposing a cannon ball projected from the pole, it is clear that it could not reach the point aimed at, but would deviate to the right in proportion to the distance and the time of its striking the ground. The same effect will prevail in our latitudes, but the deviation of the shot is too momentary to have any influence in practice.

GEO. BUCHANAN.

14 *Duke Street,*
Edinburgh, June, 1851.

* Another experiment is striking and curious, as it appears to have been the one which first arrested Foucault's attention. It consists in fixing on the axis of a turning-lathe a steel wire sufficiently flexible to permit the extremity to make sensible vibrations in any direction on being withdrawn from the centre of motion, and then left to vibrate in any plane. When the lathe is then turned, giving the wire a rotatory motion round its axis, the vibratory motion is observed still to go on in the same plane; and it was, I believe, a train of reasoning on this simple fact that led Foucault to his singular discovery. Many might have observed the fact—and many such facts may be open to observation—but how few are destined to make such brilliant applications!

STOP-COCK WITH CONICAL LEATHERS.

The *Practical Mechanic's Journal* for June last informs me, that Messrs. Stock and Son of Birmingham have registered a stop-cock of this class. May I beg the favour of your stating, that, on the 12th of February, 1849, I brought forward, at the Royal Scottish Society of Arts, a precisely similar valve? At that time I exhibited a working model of my improved hydrostatic press, as will be seen on referring to your notice of the Society's proceedings, at page 22 of your 2d volume, and to this press the valve in question was attached.

For this invention, I gained the Society's £20 medal; I cannot, therefore, pass over in silence the re-invention to which I have referred.

HAY DALL.

Glasgow, June, 1851.

TENNANT'S GRUBBER.

The universal approval which this implement has met with amongst the Lothian and Berwickshire farmers, has stimulated me to the exertion of still further improving upon it in point of execution, or getting through its work. After long deliberation, I have adopted the square section of tooth as best fitted for the purpose; and the test of this form, in conjunction with my foreman and an experienced ploughman, has shown this modification to be a vast improvement. It is perhaps not too much to say, that it is now twice as efficient as before. I have, in addition, improved the action of the pilot wheel, by excluding the sand from its bearing, and forming it so as to retain the oil upon the rubbing surfaces.

Along with this grubber, I have now the satisfaction of submitting to the public, the system of agriculture which I have pursued on my farm of 400 acres for the last ten years. My plan is this:—So soon as the crop is removed from the land—if mown or low cut, so much the better—I commence grubbing on the end ridge, going round and round the field till there is one turn given on the end of the ridge. If two grubbers are working, a pair of harrows may follow. I next turn and go over the same ground backwards, followed by harrowing. The end ridges are thus done before being consolidated or trampled by the horses. I then begin on the ridges longitudinally, going about half the depth of the furrow, following with a stroke of the harrows. This operation being completed, I cross the ridges with the grubber a little deeper, and harrow. If the land be foul, a third turn may be required with harrowing.

A pair of horses can easily grub three Scotch acres per day in winter, and four in spring, unless the land be very foul, and the winter open. By spring, the weeds will have nearly disappeared. Should it be found necessary to take off any of them, they are easily freed from the earth, and may be collected by a hand-rake at half the cost of hand-picking.

The months of April and May being arrived, the land should be substantially ploughed across, harrowed, rolled, and have one more turn of the grubber to complete the pulverization. By this time the practical farmer will be much satisfied with the result of his labour. His land will have received far more benefit from the atmosphere; and I do not hesitate to say, that when compared with the old way of working, he will have saved £1 per acre by following the method above described. The £1 per acre of a saving on my land is 10 per cent. on the rent, which, I presume, will not be thought unacceptable in the present depressing times.

In support of what I have advanced, it is necessary to state objections to the old or common method. First, then, instead of taking the weeds when above ground, they are ploughed in, where they vegetate and gain strength till spring, when they have become riveted to the soil, and are very expensive to get out. The land having lain in whole furrows, unbroken down, has received no atmospheric benefit. It has only been wasted by the frost and winds. No doubt, it may be said, it is preparing to pulverize; but pulverization is not the enriching process of itself, it is merely the means, and without it the land can receive no benefit from the atmosphere.

This process I perform in autumn, and the land is still further worked up by the frost, admitting the air to a free and minute circulation to fertilise it. All land should be kept in this state when there is no crop on it. By the old plan, it is delayed until spring.

JOHN TENNANT.

Shields, Monkton, Ayrshire,
June, 1851.

SELF-ACTING LUBRICATORS.

Having the management of a steam-engine of 60 horse power, I should feel greatly obliged if you, or some of your valuable correspondents, would inform me, through your *Journal*—which is considered the best self-acting instrument for giving a regular supply of tallow to the engine piston when at work—where to be bought—and the price.

Ely, June, 1851. E. S.

[Our correspondent will find a simple apparatus of the kind in our pages for the present month.—ED. P. M. JOURNAL.]

DOUBLE-EXPANSION STEAM-ENGINES.

In your *Journal* for May last, there is a plan for a double-expansion horizontal engine, similar to my engine in principle, by Mr. A. Morton of Dundee, intended, no doubt, as an improvement—that improvement to consist in equalizing the pressure of steam in the small cylinder when making the down stroke. I suppose Mr. Morton lost sight of the fact, that if he has by this means obtained one-fourth more area on the large

piston, he has lost one-fourth of the effective pressure of the steam, by means of having the two cylinders full of steam at the same time—that is, at the termination of the down stroke; therefore, as regards the economy of steam, this is no improvement. The benefit of vacuum is just the same in each, exclusive of unavoidable leakage through the additional stuffing-box, where, also, there is extra friction when compared with my engine. Mr. Morton's idea is ingenious, but he must adopt some better plan before your mechanical readers will be able to acknowledge that he has made any improvement.

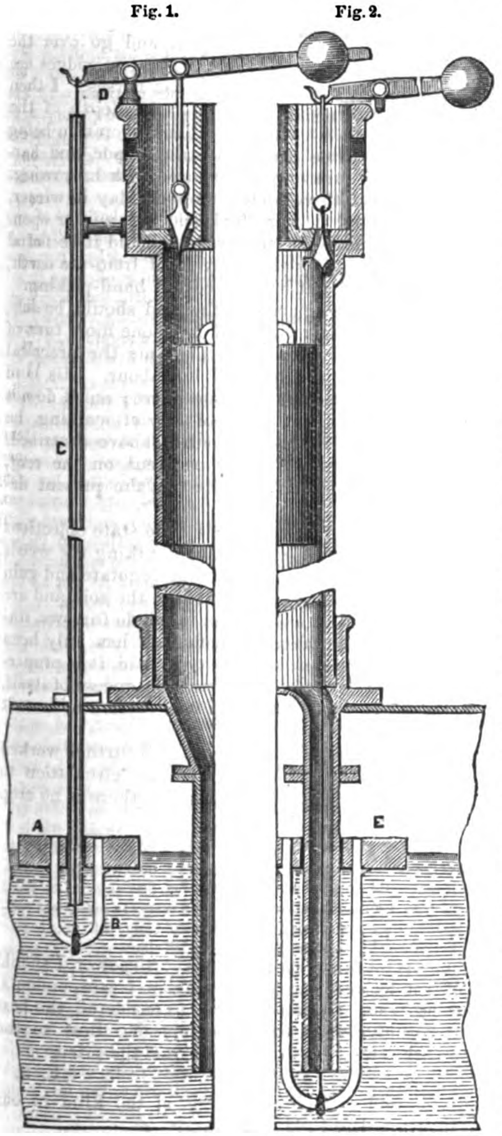
James Sims.

Redruth, Cornwall, June, 1851.

MORTON'S FEED APPARATUS FOR STEAM-BOILERS.

My object in this modification of the well-known hydrostatic feed-pipe apparatus, for supplying boilers with water, is twofold. First, the removal of the very disagreeable constant escape of steam from the stuffing-box of the ordinary float wire; and second, the prevention of the occasional stoppage of the feed by the effect of the motion of the water in bending the wire, and preventing it from working through its stuffing-box. In my sketches, figs. 1 and 2, I have represented two arrangements for accomplishing these improvements. For the sake of convenience, I have shown two half vertical sections of a feed-pipe, with the requisite connections. The plan of fig. 1 may, perhaps, be most convenient for boilers already fitted up. The float, A, inside the boiler, is attached to its actuating wire by a bridge connection, B. The wire fastened at its lower end to the centre of the bend of the bridge piece, passes up through a tube, C, of small bore, open at both ends, and standing up to the level of the feed cistern, whilst its lower end dips beneath the boiler water-line. This tube also answers as a guide for the float, which is bored through the centre to work upon the end of the tube. In this plan, the water column in the small tube balances the steam pressure, and the float wire is thus conveniently passed out of the boiler to the supply-valve lever, D, without involving the use of a stuffing-box. In fig. 2, the arrangement of the float in the boiler is on a similar principle, the float, E, being guided by the lower end of the feed-pipe itself, the wire passing up through this pipe to the feed-valve, F, which, in this case, opens downwards, to suit the direct connection with the float. Thus, in both plans, the water column is turned to account in enabling the engineer to dispense with the stuffing-box; at the same time avoiding all risk of derangement from the bending of the float wire.

Fig. 1. Fig. 2.



Alexander Morton.

Dundee, June, 1851.

SCREW-PROPULSION WITH A SINGLE ENGINE.

An interesting experiment has just been tried with the *Encounter's* engines, viz.,—as to whether one engine can be made to work alone, when applied to the screw. The experiment has been ordered for trial in all the screw-ships in Commodore Martin's squadron, in consequence of an accident having disabled one of the engines of the *Wasp*, an auxiliary screw-corvette, on the coast of Africa. The *Encounter's* engines are by Penn, 360 H. P., and are of his patent "trunk" design—that is to say, the cylinders are horizontal, and on each side of the piston there is a cylindrical tube, within which the connecting-rod vibrates, working on a journal at the centre of the piston. The object of extending the trunk to the opposite end of the cylinder is to equalize the piston surface on its two sides, and also to provide additional bearing surface to resist the lateral strain of the connecting-rod. I mention these details, merely to convey an idea of Penn's peculiar construction, as the original design of the trunk engine is pretty well known. It is to be found in one of Watt's patents. There are but two pairs of them in use —the second is in the *Arrogant*, and they are indisputably the best screw-engines we have. *Mais revenons à nos moutons*—the *Encounter's* engine would not go over the centres on the first trial; but, subsequently, the difficulty was overcome, and the ship was propelled at $5\frac{1}{2}$ knots—being about half her full speed. I am not in possession of any detailed information as to this experiment; but if I should hear anything interesting, I will mention it another time, when I also hope to describe a similar trial with the *Dauntless*. The difficulty with the *Encounter* arose from her not having any hand-gear for moving the slides, being fitted with the link motion; but the *Dauntless* has hand-gear, and, besides, the engines do not drive the screw direct, as in the *Encounter*, but through spar gearing, the wheels of which weigh some tons; and therefore the probability is, that one engine will start very well singly. This is an advantage that we may willingly hand over to the advocates for gearing, and a low speed of piston, with all its train of heavy weights, complication of machinery, and filling up of room. I am of opinion that single engines might be very beneficially introduced into our small auxiliary schooners, up to say 70 H. P.: they are advantageous in point of simplicity and cheapness; and, with a high speed of piston, and the pitch of the screw fine, the motion would be sufficiently regular. A high speed in the air-pumps may be completely overcome by the use of india-rubber valves, as is demonstrated in nearly all our screw vessels in the navy—the *Encounter's*, for instance, have the same stroke as the piston, being, in fact, connected directly to it, and their velocity is 70 revolutions × 2 feet 3 inches stroke per minute.

R. N.

Lisbon, June, 1851.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ROYAL SCOTTISH SOCIETY OF ARTS.

Nov. 11, 1850.

"An account of the Chimney of the Edinburgh Gas Works, with observations on the principles of its strength and stability," by G. Buchanan, Esq., C.E.

It was about the year 1848, owing to the extension of the works, that it became necessary to obtain increased chimney accommodation, both for increasing the draft of the furnaces, and for carrying off the smoke and vapours from the works, and clear away from the neighbourhood by raising the chimney to a greater height. Three chimneys were then on the works, the highest of them rising 148 feet, and not exceeding $2\frac{1}{2}$ feet square internally at the top. These gave vent to the smoke and vapours of 68 furnaces, heating 178 retorts, but were inadequate to work these effectually, and to give proper ventilation for cooling and purifying the retort-houses for the comfort of the workmen, still less to meet the extensions of the works then contemplated and since executed. Instead of continuing, however, the system of small and low chimneys, and adding to their number, the plan came to be considered of raising one single chimney, sufficiently large and lofty to receive the flues from all the furnaces, and by one powerful column of heated air to work these, and any contemplated extensions, in a more effectual manner than hitherto, and so as to supersede the others, and render any addition unnecessary for a long period. The idea had been acted on in some works already, and the magnificent chimney of St. Rollox chemical works furnished a favourable example. No way deterred, therefore, by the anticipated difficulties, or the great cost of the under-

taking,* seeing especially that it promised beneficial results to the public, the Directors determined to proceed with the plans made out at their request by Mr. Taylor, the Company's engineer for the works. Before proceeding, however, with a work of such magnitude, and involving such serious responsibility, the Directors considered it necessary to obtain further professional advice; and having called on Mr. Buchanan for his opinion and assistance, he then carefully considered the whole subject, and having examined also the works of the French engineers who had written on the stability of lighthouse towers and other similar structures, he communicated his opinion in two different reports, which were approved of by the Directors.

Mr. Buchanan then proceeded to state from these reports some of the facts and principles regarding the work, which apply generally to all similar undertakings. And first, in regard to the form of the structure, whether round or square; the square had been usually adopted in the works, but in the case of an altitude from 300 to 400 feet, rising 20 feet above the top of Nelson's Monument, the round form was decidedly to be preferred, as presenting a less effective surface to the wind, whose violent action in this quarter it was important to diminish by every means. The effect of the wind on a cylindrical surface, as compared with a square, had been calculated by theory in the ratio of two to three. This is the law of resistance so beautifully demonstrated by the commentators on Newton's Principia. Subsequent experiments had proved the effect on the globe and cylinder to be, if anything, rather less than theory, so that we are quite safe in taking it at $\frac{2}{3}$; the result is, that with 300 tons, for example, acting on a square tower, we have only 200 on the cylinder of the same diameter, which is most material. The bricks also, by being moulded to the circle, can be built and bound together with all the strength of the arch. On the lower part of the building, again, which is less exposed, and to be built of stone, the square and pedestal form are preferable.

Secondly, The building being intended to be 300 feet and upwards in height, the question arose how far the ordinary brick could withstand the pressure arising from so lofty a column. This difficulty was provided for by the increasing thickness of the walls of the chimney from the top towards the bottom, whereby the incumbent pressure being distributed over a larger and larger surface in descending, was diminished in proportion. The whole height from the foundation to the top is 341$\frac{1}{2}$ feet; of this 77$\frac{1}{2}$ feet are occupied by the foundation and square pedestal of stone, and 264 by the brickwork, the thickness of which was diminished towards the top by five successive steps. The upper division extended 83 feet down, and was 15 inches thick, and the internal diameter 11 feet 4 inches at top; the 2d division, 58 feet and 20 inches thick; the 3d, 48 feet and 25 inches; the 4th, 40 feet and 30 inches, and the 5th, 35 feet and 35 inches thick,—and internal diameter 20 feet. On calculating the weight and pressure on each of those divisions, on the first it was found not to exceed 4$\frac{1}{2}$ tons on each square foot; in the middle it increased to 7 tons, and at the base it increased to 8 tons on each square foot. The strength of ordinary brick being estimated at from 20 to 30 tons, the work seemed within the limits of safety; but on finding that a composition brick could be obtained in the neighbourhood, from the brickworks of Mr. Livingstone of Joppa, of much superior strength, somewhat similar to those of St. Rollox, Mr. Buchanan strongly recommended these, and also suggested experiments on their strength, of which he would give farther details on another evening, but found the first specimen tried bore at the rate of 440 tons to the square foot, a degree of strength almost incredible in such material. The results of the other experiments were somewhat similar, and all such as to set at rest any fears of the result. In regard to the sufficiency of the foundation itself, although this sustained the whole mass of the building, amounting to 4000 tons, yet the weight being spread over the entire area of the solid base, 40 feet square, it did not exceed two and a half tons to the square foot. And the material consisting of very hard Till, or blaes, of pretty equal solidity throughout, this appeared to form a good and sufficient foundation; and in order to be perfectly secure, the building at one of the angles was carried deeper than the rest, to obtain the same hard and solid bearing throughout. The result of these precautions it is now very satisfactory to observe, the structure standing perfectly upright and entire, without a crack or flaw of any description to be found in it.

The next object of importance that came to be considered was the effect of high winds on the building. From experiments, it was calculated that the force of a storm or tempest is equal to 12 lb. on the square foot of surface directly exposed; a great storm 18 lb., a hurricane 30 lb., and one capable of tearing up trees and oversetting buildings 50 lb. There is no instance, however, of such a hurricane occurring in this country, and we are quite safe in assuming 40 lb. per foot, or 90 miles an hour, as the utmost power of the wind in this country. The French engineer, Fresnel, in an interesting memoir on the stability of the lighthouse of Belleisle, and various other lighthouse structures compared with it, has assumed the force of the wind at 55 lb., agreeing with the estimate of another engineer, Navier; but this is evidently much beyond the truth, and the effect was to bring the gas-chimney in Paris below the zero of stability, although it stands as yet quite secure. Consider only the human body, which presents a surface of from four to six feet square. Such a force of wind would be equal to a pressure of from 200 to 300 lb., and the power to overset at least equal to 500 lb., which no one could sustain for a moment, and even the ordinary enclosure-walls or chimneys would be immediately prostrated by it. Besides, it appears from observations of wind guages, and particularly of one by Mr. Adie of this city, that the greatest force indicated on it for several years was only 14$\frac{1}{2}$ lb.; and another guage, kept for several years at Granton Pier, and now at the Observatory, never indicated more than 18$\frac{1}{2}$ lb., and this was at Granton on the 9th and 27th of April, 1817. If we allow 40 lb., therefore, we are quite safe, this being nearly double what ever occurs.

Another point must be kept in view, that the tendency to overset the structure is greatly increased by the altitude, and this in fact exactly in proportion as the height exceeds the breadth of the base. It might happen also, if the strength of the different portions of the column were not duly proportioned, that it might be overset, not by the base, but at some intermediate point between it and the top. Applying these views, it was found that in the upper division, 83 feet down from the top, the force of the wind was 14$\frac{1}{2}$ tons, and this increased by the height and narrow base to 70 tons, while the actual weight was 270, giving a preponderance of stability of 3$\frac{3}{4}$ to 1.

Taking the middle division, 189 feet from the top, the force of the wind was 37 tons, and this increased by altitude to 318 tons; but the weight of the structure being 880, there still remains a preponderance of stability of 2$\frac{3}{4}$ to 1.

At the base of the column the force was 63 tons, increased by height to no less than 630, while the weight was 1,670 tons, giving a preponderance of 2$\frac{3}{4}$ to 1, or rather less than the other points, and showing that the column could not overset but at the base.

At the base of the pedestal, again, the stability was fully greater, being 3$\frac{1}{2}$ to 1.

These results appeared very satisfactory, and the execution of the work has strikingly confirmed them. The stability and steadiness of the chimney, even in high winds, is remarkable; and while the old chimney, which is not half the altitude, is seen oscillating most sensibly by the naked eye, it is difficult to detect the smallest movement in the other by accurate telescopic observations with the theodolite. It is only in a violent gale, such as occurred last Thursday, that even then a slight degree of oscillation could be distinctly observed. And when we consider how very usual it is for structures of this kind to oscillate in high winds—and even some of the lighthouses, which are of a more solid character, are not exempt from it—it is a strong proof of the strength of the work.

Drawings were then exhibited, and the comparative stability calculated of the small gas chimney, and of several other chimneys here and in France, all which were considerably below the present, and the French one pronounced by Fresnel as showing great hardihood—also the relative proportions and heights of some lighthouses; and lastly, a comparison was made, and drawings exhibited and described, of the great chimney of St. Rollox, 455 feet in height, and consisting externally of a single cone tapering from the base to the summit, but not quite regularly, 41 feet in diameter at the base, and 13 at the top. The walls are in five divisions, increasing in thickness from top to bottom.

Another source of danger to be guarded against in these chimneys is the intense heat which often arises from the furnaces, and the powerful draft of the chimney. As a protection, an interior tube or chimney is generally built of brick standing clear of the outer chimney, and on which the effects of intense heat may be expended before it reaches the main exterior chimney. This is very effectual, but still the heat is great in issuing from the inner chimney, which should not be carried too high. In the present case, the inner chimney, 13 feet diameter, and lined with fire-brick, rises only 70 feet, and the walls of the chimney being then 35 inches thick, present great resistance; but as an additional precaution, he recommended near this part hoops of iron, which have been carried at intervals of 35 feet all the way up within, and enclosed by the brickwork, so that they are not visible.

The only point remaining to be considered, and to which Mr. Buchanan's attention was particularly called, was the expediency of protecting the building by a lightning conductor. He had formerly, when the old chimney was erected, been consulted as to this, and considered it unnecessary, the height being moderate, and doubts being then entertained of the efficacy or expediency of such instruments. Much, however, has since been added to our knowledge and experience on this subject, and on the beneficial operation of conductors, so that he had no hesitation, the altitude also being so much greater, in recommending it. But having requested to be favoured with the views of a friend, and high authority, Professor Faraday, he gave an extract from his letter as follows:—"The conductor should be of $\frac{1}{2}$ inch copper rod, and should rise above the top of the chimney by a quantity equal to the width of the chimney at the top. The lengths of rod should be well joined metallically to each other, and this is perhaps best done by screwing the ends into a copper socket. The connection at the bottom should be good; if there are any pump pipes at hand going into a well, they would be useful in that respect. As respects electrical conduction, no advantage is gained by expanding the rod horizontally into a strap or tube—surface does nothing, the solid section is the essential element.† There is no occasion of insulation (of the conductor) for this reason. A flash of lightning has an intensity that enables it to break through many hundred yards (perhaps miles) of air, and therefore an insulation of six inches or one foot in length could have no power in preventing its leap to the brickwork, supposing that the conductor were not able to carry it away. Again, six inches or one foot is so little that it is equivalent almost to nothing. A very feeble electricity could break through that barrier, and a flash that could not break through five or ten feet could do no harm to the chimney.

"A very great point is to have no insulated masses of metal. If, therefore, hoops are put round the chimney, each should be connected metallically with the conductor, otherwise a flash might strike a hoop at a corner on the opposite side to the conductor, and then on the other side on passing to the conductor, from the nearest part of the hoop there might be an explosion, and the chimney injured there or even broken through. Again, no rods or ties of metal should be wrought into the chimney parallel to its length, and therefore to the conductor, and then to be left unconnected with it."

*** The whole cost of the work has been little short of £5000. One of much less magnitude would have been sufficient for immediate wants; but after due consideration they thought it best to do the plan effectually at once.**

† The very reverse of what was formerly held by high authorities.

In answer to some further inquiry, Professor Faraday again writes:—

"The rod may be close along the brick or stone, it makes no difference. There will be no need of a rod on each side of the building, but let the cast-iron hoop, and the other you speak of, be connected with the rod, and it will be in those places at least, as if there were rods on every side of the chimney.

"$\frac{3}{4}$ rod is no doubt better than $\frac{1}{2}$ inch, and except for expense I like it better. But $\frac{1}{2}$ inch has never yet failed. A rod at Coutts' brewery has been put up $1\frac{1}{2}$ inches diameter—but they did not mind expense. The Nelson column in London has $\frac{1}{2}$ inch rod, $\frac{3}{4}$ is better.

"I do not know of any case of harm from hoop-iron enclosed in the building, but if not in connection with the conductor, I should not like it; even then it might cause harm, if the lightning took the end furthest from the conductor."

The rod was constructed nearly according to these directions, of $\frac{5}{8}$ inch copper, and the effect of it was very remarkably exemplified during the progress of the work. It was carried up regularly along with the building, and during storms, or a very electric state of the atmosphere, the electric fluid was distinctly perceived rushing down the rod, by a loud singing noise given out by it, arising from a tremor or vibration into which it was thrown, by a little play in the studs or eyes through which it passed in the building; and during these times the workmen were by no means fond of approaching too near it, but no harm ever occurred to any one from it.

The work of the chimney was commenced by laying the foundation on the 3d of June, 1845, and during the course of that season the masonwork of the pedestal was completed, and the work allowed to stand till the spring. The brickwork of the shaft was commenced on the 2d of May, 1846, and proceeded rapidly during the summer. The bricks and all the materials were taken up in the inside by means of a steam-engine working at the bottom, and winding a rope over a barrel, and this passing over a pulley on the top of the building, the materials were raised with the greatest facility; and it was curious to observe from different parts of the tower the work gradually rising, and the workmen steadily going on, at the great elevation to which they at last attained. A model was shown of a very simple apparatus, by which the stage for the materials and timbers was raised by successive lifts, as the building rose in height.

The contractors for the masonwork of the stone pedestal were Messrs. Gowan, and for the brickwork of the stalk Messrs. Bow of Glasgow, to whom much credit is due for the superior style in which they have finished their work; and it may also be mentioned, that no accident or casualty of any serious nature occurred during the execution of this great work.

In the second portion of his paper, Mr. Buchanan concluded with some observations on the effects of the draft in the chimney, a subject of great importance in regard to chimneys generally for large furnaces, where enormous quantities of air are continually passing in the act of combustion. This had been estimated by the eminent chemist, Professor Thomson of Glasgow, at 150 cubic feet per minute for every pound of coal consumed, and 50 more for waste—in all, 200. Hence in the boilers of many steam-vessels, for example, consuming one ton per hour, 7,400 cubic feet of air per minute must pass up their narrow funnels, and being limited also in height, must be raised to a high temperature, and this, as at present constructed, by a great sacrifice of fuel. In the Gas Works, the 68 furnaces consume 34 tons in 24 hours, requiring a current of air at the rate of 10,000 feet per minute, which the old chimneys were incapable of drawing. Mr. Buchanan then stated the principles on which the power of draft must be calculated, referring to the article "Furnace" in the Encyclopædia Britannica, last edition, where he had occasion to explain the subject. The power of the draft was directly proportional to the height of the chimney, and the velocity with which the external air rushes in to supply the draft, was proportional to the *square root* of the height of the chimney. The internal heat, however, was the grand moving power, expanding the air within the chimney, and giving it a buoyant or ascensional power. With 488 degrees of temperature, the celebrated chemists, Petit and Dulong, and most accurate observers, had found that air expands into double its volume. With this temperature, therefore, within the chimney, the velocity with which the external air was capable of entering at the bottom of the chimney, or into the furnaces or flues, would be proportional to the square root of half the height of the chimney, and expressed numerically in feet per second, would be equal to six times the square root of half the height, or $V = 6\sqrt{\frac{H}{2}}$, V being the velocity in feet per second, and H the height of the chimney. This forms an easy rule for this particular temperature; and if we apply to it in the present case, taking the height of the chimney from the entrance flue at 330 feet, would give a velocity of about 50 feet per second, or 34 miles an hour, equal in the atmosphere to a very violent gale of wind. Taking the smallest area of the chimney, where it is 11 feet 4 inches in diameter, at 100 square feet, this with such a power of draft would be capable of discharging 30,000 cubic feet per minute, which is amply sufficient for the present works and any extensions. The actual results have proved very satisfactory. Not only is there a draft in the furnaces, whereby they are wrought most effectually and with great economy of fuel, but, by making one or more openings at the bottom of the chimney, a powerful blast of air sets in from all directions, carrying off vapours and all impurities, and producing a cool atmosphere in every part. On measuring the power of draft with a water-pressure guage, he found it drew up a column $3\frac{1}{2}$ inches high, there being a good deal of wind at the time,—the blast of air at the mouth of the opening, it is curious to observe, drawing the hand powerfully in, and a square board covering the opening it was difficult to withdraw, exerting a pressure of 15 lbs. on the square foot. High winds have a sensible effect on the draft, sometimes raising the water-guage to a height of 6 or 7 inches. A pressure of $2\frac{1}{2}$ inches, which it would be in calm weather, is very nearly equal to a column of air half the height of the chimney, and this agrees very well with the above calculation, as the interior temperature would not exceed 480 or 500 degrees. As a general rule for calculating the power of the draft at any temperature, the following would be found simple and agreeable to the practical results: $V = 6\sqrt{\frac{n\,H}{488 + n}}$, n being the number of degrees of temperature.

Mr. Buchanan then gave a detail of the experiments formerly alluded to, made upon the strength of the bricks for the chimney in fourteen specimens of different qualities and compositions. By far the strongest was the composition of fireclay and ironstone, which bore, making every allowance, from 200 to 350 tons on the square foot; while the common quality did not exceed from 60 to 120. The Hailes stone bore upwards of 450 tons, greatly more than the result found by the experiments already shown to the Society, but which, being on small specimens, 1 inch cube, while the other was 4 inches cube, the effect might partly be due to this circumstance, together with the difference of quality in the specimens.*

ROYAL INSTITUTION, MANCHESTER.

"On Voltaic Ignition and Illumination,"† by W. E. Staite, Esq.

We have dwelt longer upon the constitution of these imponderable agents than we intended; but it would be difficult, if not impossible, rightly to understand the phenomena of voltaic ignition, without a clear comprehension of the general constitution of these agents, seeing that, in the production of that most interesting and brilliant phenomenon, the voltaic arc, they are, one and all of them, intimately connected.

If we append two pieces of gold leaf to the ends of the two terminal wires of the battery or pile, and bring them within a short distance of each other, they will approach and coalesce. The intervening air—a very bad conductor—has not been able entirely, as before hinted, to prevent the transmission from one leaf to the other of some comparatively small portion of the power. We would say, then, that a circuit in this case is established, for there is a transmission of power throughout the entire chain of particles, including the intervening air. We prefer this hypothesis to that which assumes "an attracting or polarising power between the terminals before the circuit is completed." In either view, we have in these gold leaves very mobile conductors, which, under the influence of electric agency, exhibit the phenomena of attraction. Now, in the voltaic arc, we have an equally mobile conductor in the carbon atoms when intensely heated, and under the intense heating influence they are subjected to, minutely divided and separated. As soon as their cohesion with the mass of carbon forming the positive electrode is overcome by the superior expansive power of heat, these atoms fly or are repelled from the positive electrode, and are attracted by the negative electrode through the intervening stratum of heated atmosphere; and the carbon atoms which have been so parted with by the one electrode, are found to collect themselves again on the other electrode in a hard concrete button-like mass, with a pointed projection towards the discharging pole. The repulsions and attractions spoken of, indicate that these atoms—including, also, the discharging and receiving electrodes—are in a polarised state. This is evident, further, from the fact, that a magnet will attract or repel them when placed in particular directions, bending the arc out of its course, and in certain cases causing rotations. By throwing the voltaic arc into shadow on a screen, by a more powerful light derived by the same means, these carbon atoms may be distinctly seen to break away from the one electrode, and attach themselves to the other, in obedience to the influences stated. (This beautiful experiment was shown.)

We see, then, that the voltaic arc, or, as it is sometimes called, "the disruptive discharge between the terminal poles," is due to the presence of exalted heat, resulting from the retardation of the electric power, in its transmission through the bad-conducting carbon, and the stratum of atmosphere intervening; and that the light resulting is due to the intense incandescence of these atoms under the influence of such heat, produced from chemical action. The calorific effects, however, from voltaically ignited substances, differ according to their molecular structure, and the nature of the surrounding media in which the ignition takes place. Mr. Grove, who has explained this very carefully, observes—"An ignition which is manifest to the senses in certain media, such as atmospheric air, is imperceptible without a more refined examination when in hydrogen gas and many of its compounds. This is traceable to the cooling effects of the latter gases, not dependent upon their specific levity, their specific heat, or their conducting power, but apparently upon a molecular constitution which enables them more rapidly to convey away the heat generated." The colour of the light is dependent upon the nature of the material forming the electrodes. With carbon, the light is a pure white,—pure as the sunbeam, or nearly so,—and which, when decomposed by the prism, exhibits the three primitive rays in their due order, proportion, and depth of colour. The different metals yield varied results; lead giving a purple light, silver an emerald green, and so on.

The length of the voltaic arc, and the amount of light radiated, depend upon both intensity and quantity of electric power transmitted.

* In the very interesting work lately published by Mr. Edwin Clark on the Britannia Bridge, and containing many valuable and curious results, well deserving of attention, on the strength of materials, some experiments are described on the compression of brick and stone in large specimens, and where the pressure was applied, not by lever or hydraulic power, but by the direct accumulation of masses of material heaped up above the specimens till they were crushed. The bricks, however, he says, were soft, and did not bear above 30 or 40 tons, but some of the limestone bore upwards of 500 tons.

† See *ante*, Pp. 69 and 70, Vol. IV.

If the intensity, or electro-motive energy, be small, it will only force a passage of limited extent—say the thickness of a sheet of paper—and the arc will consequently be maintained only so long as the electrodes are kept at that short distance apart; but if the electro-motive energy be increased, then an arc, even to the extent of several inches in length, may be obtained, according to such increased intensity. If the quantity of the electric power be small (comparatively speaking), the heating effects will be small, and the radiated light small also, whatever the length of arc may be; but by increasing the quantity, the intensity being the same, the luminosity becomes greatly increased. For the amount of radiant light, from whatever source we obtain it, increases in a vastly greater ratio than the increase of temperature. If, then, it be accompanied by a great expenditure of power, to maintain from voltaic ignition any substance at a small increase of temperature beyond incipient voluminosity, it will be attended with far less expenditure of power to obtain the same amount of light from a diminished illuminating surface. Hence the proportion of luminosity from a given power producing it, becomes exceedingly high when the heated surface is concentrated, as in the case of the carbon points, or rather the space occupied by the disruptive discharge.

We have, again, in the voltaic arc, another illustration of the necessity of the presence of solid matter for the radiation of light. In the common candle, we have not only the element hydrogen, but carbon also, without which but little light would result, hydrogen possessing but feeble powers of illumination. The combustion of hydrogen and oxygen yields but feeble light also, but when the lime-ball is added, we have the solid matter to be thrown into an incandescent state by the heating power of the gases, and the consequence is, intense luminous radiation. So, with regard to heat and light from voltaic sources, we have the heating power and the carbon in circuit, in which the heating power is concentrated; and the resulting phenomena are the same in principle as those developed or obtained by the hydrogen and the carbon of the candle, or by hydrogen and carbon in ordinary gas-light; namely, they are dependent upon the presence of solid matter in a highly exalted state of incandescence, resulting from an intense concentration of heat in and throughout the particles themselves.

We may mention, lastly, that voltaic ignition is not dependent upon oxygen or the presence of atmospheric air for its support. The phenomenon may be exhibited with undiminished effects in vacuo, under an hermetically sealed glass; and we have frequently exhibited it when the electrodes have been immersed in water. In the latter case, certainly, the water suffers decomposition, and we cannot say that oxygen is not present; but in the former case the experiment is conclusive against the presence of oxygen or any other supporter of combustion.

We have seen that the imponderable agents are probably only manifestations of one great central force. The equivalents, however, of these agents are not yet ascertained. It may be expected, however, that by careful investigation, and well-directed experiment, this most interesting and important problem in science will in due time be solved. These equivalents once discovered, science will advance with a rapidity hitherto unprecedented, and much that is still obscure and apparently contradictory in some of the phenomena we have been considering, will appear clear, consistent, and in unity with settled law.

ON BOILERS AND BOILER EXPLOSIONS.

By W. Fairbairn, Esq., F.R.S.

[The following paper was recently read by Mr. Fairbairn at the Leeds Mechanics' Institution. The great weight of the author's opinions on questions of this nature will, we presume, furnish an ample reason for its transfer to our columns.—Ed. P. M. Journal.]

I propose to consider the boiler in its *construction*, *management*, *security*, and *economy*.

I.—As to the construction. Here I shall have to go a little into detail, in order to show, in construction, the absolute necessity there exists for adhering to form and other considerations essential in the practice of mechanical engineers, in effecting the maximum of strength with the minimum of material. In boilers this is the more important, as any increase in the thickness of the plates obstructs the transmission of heat, and exposes the rivets as well as the plates to injury on the side exposed to the action of the furnace.

It has generally been supposed that the rolling of boiler plate-iron gives to the sheets greater tenacity in the direction of their length than in that of their breadth; this is, however, not correct, as a series of experiments which I made some years since fully proves that there is no difference in the tensile strength of boiler-plates when torn asunder in the direction of the fibre, or across it. From five different sorts of iron the following results were obtained:—

Description of Iron.	Mean breaking weight in tons in the direction of the fibre.	Mean breaking weight in tons across the fibre.
Yorkshire plates,	25·77	27·49
Yorkshire plates,	22·76	26·37
Derbyshire plates,	21·68	18·65
Shropshire plates,	22·82	22·00
Staffordshire plates,	19·56	21·01
Mean,	22·51	23·10

From this it appears that we may safely use iron-plates in the construction of boilers in whatever direction may best suit the convenience of the maker. Next to the tenacity of the plates, comes the question of riveting, or the best and surest means of securing them together. On this part of the subject we have been widely astray, and it required some skill, and no inconsiderable attention, in conducting the experiments, to convince the unreflecting portion of the public—and even some of our boiler-makers—that the riveted joints were not stronger than the plate itself. At first sight this would appear to be the case, but a moment's reflection will soon convince us to the contrary; as in punching holes along the edge of a plate, it is obvious that the plate must be weakened to the extent of the sectional areas punched out, and that it is next to impossible, under the circumstances, to retain the same strength in the material after such diminution has been effected as existed in the previously solid plate. This was clearly demonstrated by a series of experiments which took place some years since, and in which the strength of almost every description of riveted joint was determined by tearing them directly asunder. The results obtained from these experiments were conclusive as regards the relative strength of riveted joints and the solid plates. In two different kinds of joints—double and single riveted—the strengths were found to be, in the ratio of the plate, as the numbers 100, 70, and 56.

Assuming the strength of the plate to be	100
The strength of a double-riveted joint would be, after allowing for the adhesion of the surfaces of the plate,	70
And the strength of a single-riveted joint,	56

These proportions of the relative strengths of plates and joints may therefore, in practice, be safely taken as the standard value in the construction of vessels required to be steam and water tight, and subjected to pressure varying from 10 lbs. to 100 lbs. on the square inch.

In the construction of boilers exposed to severe internal pressure, it is desirable to establish such forms, and so to dispose the material as to apply the greatest strength in the direction of the greatest strain; and in order to accomplish this, it will be necessary to consider whether the same arrangement be required for all diameters, or whether the form as well as the disposition of the plates should not be changed. To determine these questions in cylindrical boilers, recourse must be had to experiment, or such deduction as may apply to any given case, and such as is founded upon unerring data derived from experimental research. On this head I am fortunate in having before me the calculations of Professor W. R. Johnson, of the Franklin Institute of America, whose inquiries into the strength of cylindrical boilers are of great value, and from which the following short abstract may be useful.

"*1st*, To know the force which tends to burst a cylindrical vessel in the longitudinal direction, or, in other words, to separate the *head* from the curved *sides*: we have only to consider the actual area of the head, and to multiply the units of *surface* by the number of units of *force* applied to each superficial unit. This will give the total *divellent* force in that direction.

"To counteract this, we have, or may be conceived to have, the tenacity of as many longitudinal bars as there are lineal units in the circumference of the cylinder. The united strength of these bars constitutes the total retaining or *quiescent* force, and at the moment when rupture is about to take place, the *divellent* and quiescent forces must obviously be equal.

"*2nd*, To ascertain the amount of force which tends to rupture the cylinder along the curved side, or rather along the opposite sides, we may regard the pressure as applied through the whole breadth of the cylinder upon each lineal unit of the diameter. Hence the total amount of force which would tend to divide the cylinder in halves, by separating it along two lines on opposite sides, would be represented by multiplying the diameter by the force exerted on each unit of surface, and this product by the length of the cylinder. But even without regarding the length, we may consider the force requisite to rupture a *single band* in the direction now supposed, and of one lineal unit in breadth; since it obviously makes no difference whether the cylinder be long or short, in respect to the ease or difficulty of separating the sides. The *divellent* force in this direction is therefore truly represented by the diameter multiplied by the pressure per *unit of surface*. The retaining or *quiescent* force, in the same direction, is only the strength or tenacity of the two opposite sides of the supposed bond. Here, also, at the moment when a rupture is about to occur, the divellent force must exactly equal the quiescent force."

Mr. Johnson then goes on to show, that as the diameter is increased, the product of the diameter and the force or pressure per unit of surface is increased in the same ratio. This truism I shall endeavour to prove; as also, that as the diameter of any cylindrical vessel is increased, the thickness of the metal must also be increased in the exact ratio of the increase of the diameter—the pressure, or, as Mr. Johnson calls it, the divellent force being the same. When the diameter of a boiler is increased, it must be borne in mind that the area of the ends is also increased, not in the ratio of the diameter, but in the ratio of the square of the diameter; and it will be seen, that instead of the force being doubled, as is the case in the direction of the diameter and circumference, it is quadrupled upon the ends, or, what is the same thing, a cylinder double the diameter of another cylinder has to sustain four times the pressure in the longitudinal direction.

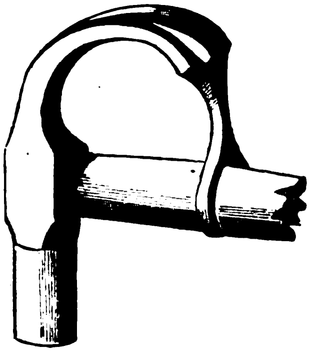
MONTHLY NOTES.

Election of Fellows of the Royal Society.—At the annual meeting held during the past month, the Earl of Rosse in the chair, the following "Fifteen" had the honour of being elected F.R.S.:—Mr. Charles Cardale Babington; Thomas Snow Beck, M.D.; Mr. Charles James Fox Bunbury; Mr. George T. Doo; Mr.

Edward B. Eastwick; Captain Charles M. Elliot; Captain Robert Fitzroy, R.N.; Mr. John Russell Hind; Mr. Augustus William Hofmann; Mr. Thomas Henry Huxley; Mr. William Edmond Logan; Mr. James Paget; Mr. George Gabriel Stokes; Mr. William Thomson; and Augustus V. Walker, M.D.

THE AMERICAN STEAMER "PACIFIC."—The recent quick passage of the "Pacific," has entitled her engineers to a silver vase, some time ago promised by the proprietors of the line, to the men whose ship first performed the trip either way, under ten days. Although retarded by head-winds for about one-third of the passage, the "Pacific" has gallantly won the prize. The engineers to whom the vase must be awarded in virtue of the owners' offer, are—Daniel B. Martin, chief engineer; Nathan Thompson, jun., and John C. Thompson, first engineers; Alexander Cunningham and Beverley Parkis, second engineers; and William Russell and William Harris, third engineers.

THE EXTINCTION OF VESUVIUS.—Mr. Goldsworthy Gurney's brilliant achievement of the complete extinction of the great burning waste in the coal-field of Clackmannan, is a scientific feat worth the noting; but what are we to think of a grave proposal to put out the pipe of Mount Vesuvius? The bottom of the main crater is said to be many thousand feet below the oceanic level. This fact, if it be one, in itself furnishes a reply to every one's question how it is to be done. Nothing is easier—on paper. Let in the sea. The promoters of the scheme have, however, gone further than the mere proposition. They have calculated the cost of making the inlet trench, and guess it to be somewhere about half a million sterling. Could the project be accomplished, an immense tract of fine land would be retrieved from lava, ashes, and ruin.



ANDERSON'S AMERICAN CLAW HAMMER.—Our sketch annexed represents a very simple and ingenious contrivance for strengthening and steadying the head of claw hammers. Instead of a plain open forked claw, this portion is prolonged backwards and bent round, terminating in an eye, embracing the handle at a short distance from the head. Thus, in drawing nails with the claw, the handle supports and steadies the head very efficiently.

DIGNITY OF MECHANICAL PURSUITS.—It is a singular vagary that men, to whose genius and industry the world is indebted for what is most valuable in it, should have always been held in low esteem. A habit of modern —it was a passion in former—times, to look askant at those who use the hammer or spade, under the fond delusion that the less wise men have to do with gross matter, the nearer they resemble the Great Spirit; whereas God is the greatest of workers—the chief of artificers. So far from locking up his wisdom in abstractions, he is incessantly embodying it in tangible things; and in them it is that his intelligence, ingenuity, and resource are made manifest. What is this world but one of his workshops, and the universe but a collection of his inventions? In him the squeamishness of half-formed philosophers and of high-bred fashionables, respecting manual and mechanical pursuits, finds no sympathy, but terrible rebuke. His works proclaim his preference for the material and useful to the merely imaginative, and in truth it is in such that the truly beautiful or sublime is to be found. A steamer is a mightier epic than the Iliad; and Whittemore, Jacquard, and Blanchard, might laugh even Virgil, and Milton, and Tasso to scorn. There is, moreover, a morality belonging to the arts that as yet has been little heeded; a lever, hammer, pulley, wedge, and screw, are actual representations of great natural truths, and the men who revealed them may be said to have been inspired. The divine afflatus flows through many channels. In fact, all truths are allied—the decalogue being an exponent of moral, as are mechanical inventions of physical, and axioms in science of philosophical verities: hence, whatever science discovers and art applies is divine, and ultimately tends to eradicate evil; indeed, all teachings begin with the arts, and nothing is more certain than that all must end with them. If we glance at existing nations, we invariably find those that excel in arts and sciences most deeply imbued with moral principles—the foremost and most active in the benevolent enterprises of the age. Inventors, then, are revealers and expounders of the practical doctrines of civilization, and more than any other class have they shown us how to lessen life's evils and multiply its good. The connection of morals with expanding science and art, and the necessity of their union to the elevation of the species, are beginning to elicit attention. It is now perceived that deviations from principles of science—either in agriculture, arts, manufactures, in processes or pursuits of any kind—are errors, and all errors, in an extended sense, are SINS—are violations of Divine laws. And though sins of ignorance, they carry, and will for ever carry, their punishment with them, viz.: in imperfect results, and the infliction of unnecessary inconveniences, expenses, and toil, in spending strength for nought. Not till mechanical as well as ethical science is fully explored and universally applied, can man attain his destiny, and evil be swept from the earth. It has been regretted, also, as an evil of magnitude, that, while the arts administer to the necessities of the species, a general knowledge of them has not been demanded as a feature of popular education; that while the works of historians, poets, and theorists, have been adopted as models by which to form the taste and excite the ambition of youth, the great doctrines of life, as exemplified in the processes by which the products of the planet, its forces, and the properties of its substances, are converted into the elements and accessories of material and consequently of mental refinement, have been neglected. But such are errors belonging rather to the past than the present or future. Their detection is a presage of their disappearance. Evils incident to the progress of society, they, with many others, are only gradually to be surmounted. The philosophy or physics of the workshop is but beginning to be understood—true estimates of its value to be formed;—indubitable proofs, however, that the movements of civilization are onward and upward. It is now perceived that, in ordinary avocations, principles of science are invoked that furnish subjects of research to the profoundest minds, and such as may serve to quicken and enrich the perceptions of the most inquisitive.—*Ewbank.*

THE NEW IRON RIVER STEAMER "ARDENTINNY."—The "Ardentinny" is an iron vessel, built and engine-fitted during the early part of the present year, by Messrs. Wingate of Whiteinch, on the Clyde, for the Glasgow, Greenock, Gourock, Kilcreggan, Strone, Cove, Kilmun, Ardentinny, and Lochgoilhead station. Her dimensions, in builders' old measurement, are—

	Feet.	In.
Length of keel and fore-rake,	161	0
Breadth of beam,	16	$0\frac{1}{2}$
Breadth over paddles,	30	7
Depth of hold,	7	1
Length of engine-room,	46	11
Tonnage,	219	0
Contents of engine-room,	68	0
Register consequently is,	151	0

She has a single steeple-engine of Mr. David Napier's four piston-rod class, 62 horse-power nominal. Diameter of cylinder, 44 inches. Length of stroke, 3 feet 6 inches. Her paddle-wheels are of the feathering kind, 16 feet $6\frac{3}{4}$ inches in diameter, with 8 floats, 5 feet 10 inches by 2 feet $0\frac{1}{2}$ inch—the area of each being 12·75 feet. Her single boiler is a vertical tubular one, with four furnace-mouths—two fore, and two aft—by which the two furnaces are fired. The steam pressure is 16 lbs., the engine performing 42 revolutions, with a consumption of 8·4 cwt. of coal per hour. The hull is plain built—no figure-head, galleries, nor bowsprit—and having one mast. She is sloop-rigged, with one deck. Commander, Mr. P. Chambers. Her owners are a party of gentlemen in Glasgow, Lochlong, and the neighbourhood of her station.

ENGLISH PATENTS.

Sealed from 10th May, to 17th June, 1851.

William Longmaid, Beaumont-square, gentleman,—"Improvements in treating ores and minerals, and in obtaining various products therefrom, certain parts of which improvements are applicable to the manufacture of alkali."—May 10th.

Hugh Barclay, Regent-street, Middlesex,—"Improvements in the means of extracting or separating fatty and oily matters, in refining and bleaching fatty matters and oils, animal and vegetable wax and resins, and in the manufacture of candles and soap."—19th.

Perceval Moses Parsons, Robert-street, Adelphi, civil engineer,—"Improvements in cranes capable of being used on railways, and in parts of railways."—19th.

George Tate, Bawtry, York, gentleman,—"Improvements in the construction of dwelling-houses and other buildings, including floating vessels, and for the adaptation and manufacture of materials for such uses."—22d.

Benjamin Bailey, Leicester,—"Improvements in the manufacture of looped fabrics."—23d.

Alfred Vincent Newton, Chancery-lane, mechanical draughtsman,—"Improvements in the carbonization of coal, and in the utilization of the products disengaged during that operation, in improving the quality of the products intended for illuminating purposes, and in regulating of the same."—(Communication.)—27th.

Archibald Slate, Woodside Ironworks, Worcester,—"Improvements in steam-engines and steam-boilers, and in the passages and valves for the induction, eduction, and working of fluids."—27th.

John Fielding Empson, Birmingham,—"Improvements in the manufacture of buttons."—27th.

John Harrison, Blackburn, Lancashire,—"Certain improvements in the manufacture of textile fabrics, and in the preparation of yarns or threads for weaving."—27th.

A grant of an extension unto James Potter, Manchester, Lancashire, cotton-spinner, for the term of five years, from the 21st December, 1850, for his invention of certain improvements in spinning machinery.

William Crane Wilkins, Long-acre, Middlesex, engineer,—"Certain improvements in railway buffers."—29th.

Joseph Reynolds, Vere-street, Middlesex, card maker,—"Improvements in the manufacture of cards usually denominated playing cards."—29th.

John Pegg, Leicester, manufacturer,—"Improvements in producing corrugated surfaces and leather."—29th.

Henry W. Adams, Boston, Suffolk, Massachusetts, United States of America,—"An improved means of generating galvanic electricity, of decomposing water or various electrolytes, of collecting hydrogen, of burning it, or atmospheric air, separately or in combination."—29th.

Robert William Sievier, Upper Holloway, Middlesex, civil engineer,—"Improvements in weaving and printing textile fabrics."—29th.

John Ashworth, Bristol, manager of the Great Western Cotton Works,—"Certain improvements in the method of preventing and removing incrustation in steam-boilers and steam-generators."—29th.

Thomas Parker, Leeds, York, broker,—"Improvements in machinery for opening, cleaning, and preparing fibrous substances, and for manufacturing felted fabrics."—June 3.

John Hopkinson, Oxford-street, Middlesex, piano-forte manufacturer,—"Improvements in piano-fortes."—(Communication.)—3d.

William Bridges Adams, Adam-street, Adelphi, Middlesex, engineer,—"Certain improvements in the construction of roads and ways for the transit of passengers, of materials, and of goods; also in buildings and in bridges, and in locomotive engines and carriages; parts of which improvements are applicable to other like purposes."—3d.

Cornelius Alfred Jacquin, New-street, Bishopsgate, London, mechanist,—"Improvements in the manufacture of nails, pins, tacks, screws, and other similar articles."—3d.

Isaac Hazlehurst, Marton, Dalton, Lancashire, steel refiner,—"Certain improvements in the manufacture of iron."—3d.

James Banister, Birmingham, brassfounder,—"Improvements in the manufacture of metallic tubes for steam-boilers and other uses."—7th.

Robert Alexander Kennedy, Manchester, cotton-spinner,—"Improvements in machinery applicable to engines for carding cotton and other fibrous substances."—10th.

William Henry Fox Talbot, Laycock Abbey, Chippenham, Wilts,—"Improvements in photography."—12th.

John Emanuel Lightfoot, Broad Oak, Accrington, Lancashire, calico-printer, and James Higgin, Cobourg-terrace, Manchester, chemist,—"Improvements in treating and preparing certain colouring matters to be used in dyeing and printing."—12th.

Frederick Crace Calvert, Manchester, chemist,—"A new application of certain fluids for manufacturing extracts applicable to the processes of dyeing, printing, and tanning, and in the apparatus connected therewith."—12th.

John Chatterton, Birmingham, agent,—"Certain improvements in protecting insulated electro-telegraphic wires, and in the methods and machinery used for the purpose."—12th.

William Birkett, Bradford, York, agent,—"Improvements in obtaining soap from wash waters."—12th.

Felix Charles Victor Leon Levacher D'Urcle, Paris, France, farmer,—"Improvements for increasing the produce of autumn wheat."—12th.

Edward Lyon Berthon, Fareham, Hants, clerk, master of arts,—"Improvements in boats, and in instruments for sounding and indicating the rise and fall and rate of currents."—12th.

James Hinks, Birmingham, Warwick, manufacturer,—"Certain improvements in the construction of metallic reels for winding cotton, silk, and other threads, and in machinery for making the same."—14th.

Prospero Durand, Rue Maragrand, Paris, merchant,—"Improvements in communicating intelligence."—17th.

Thomas Crook, Preston, Lancashire, manufacturer, and James Mason, Preston, aforesaid, warper,—"Certain improvements in looms for weaving."—14th.

Francis John Swaine Hepburn, Notting-hill-terrace, Middlesex, captain, H. P. unattached,—"Improvements in the manufacture of carriages and other vehicles."—17th.

Godfrey Ermen, Manchester, cotton spinner and manufacturer,—"Certain improvements in the method of and apparatus for finishing yarns or threads."—17th.

SCOTCH PATENTS.

Sealed from 22d May, to 22d June, 1851.

John Gwynne, Lansdowne-lodge, Notting-hill, Middlesex, merchant,—"Improvements in machinery for pumping, forcing, and exhausting of steam fluids and gases, and in the adaptation thereof to producing motion; to the saturation, separation, and decomposition of substances."—May 28th.

Charles Hardy, Low-moor, York, engineer,—"Certain improvements in the manufacture of scythes."—30th.

William Geddes, Glasgow, Lanark, North Britain, dyer,—"Certain improvements in the production of ornamental fabrics."—June 6th.

John M'Nab, Middletownfield, Renfrew, North Britain, bleacher,—"Certain improvements in stretching and drying textile fabrics or materials, and in the machinery or apparatus employed therein."—16th.

Isaac Hazelhurst, Marton, Dalton, Lancaster, steel-refiner,—"Certain improvements in the manufacture of iron."—16th.

Frederick Crace Calvert, Manchester, Lancaster, professor of chemistry, and analytical chemist,—"A new application of certain fluids for manufacturing extracts applicable to the processes of dyeing, printing, and tanning, and in the apparatus connected therewith."—18th.

Alexis Delemer, Radcliff, Lancaster, civil engineer and merchant,—"Certain improvements in the application of colouring matter to linens, cottons, silks, woollens, and other fabrics, and to linen, cotton, silk, woollen, and other weft, and also in machinery and apparatus for those purposes."—19th.

Christopher Nickels, York-road, Lambeth, Surrey, gentleman,—"Improvements in the manufacture of woollen and other fabrics."—19th.

Henry C. Baildon, Edinburgh, chemist,—"Improvements in writing, printing, or marking letters, characters, or figures upon paper, parchment, or other materials properly prepared for that purpose."—19th.

George Robins Booth, London, engineer,—"Improvements in the manufacture of gas."—19th.

James Hartley, Sunderland,—"Improvements in the manufacture of glass."—19th.

William Beadon, Jun., Taunton, Somerset, gentleman,—"Improvements applicable to the roofing of houses, buildings, and other structures."—19th.

IRISH PATENTS.

Sealed from 21st May, to 19th June, 1851.

James Hamilton, London, engineer,—"Improvements in machinery for sawing, boring, and shaping wood."—May 22d.

Adolphus Oliver Harris, High Holborn, Middlesex, philosophical instrument maker,—"Improvements in barometers."—June 10th.

William Beckett Johnson, Manchester, Lancashire, manager for Messrs. Ormerod & Son, engineers,—"Certain improvements in steam-engines, and in apparatus for generating steam; such improvements in engines being wholly or in part applicable where other vapour and gases are used as the motive power."—10th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 15th May, to 17th June, 1851.

May 15th, 2815. Palmer & Nevill, Liverpool-street, King's-cross,—"Ready reacher."
— 2816. Mathew Naylor, Newgate-street,—"Shirt and chest protector for waistcoats."
16th, 2817. James E. Boyd, Lower Thames-street,—"Double-action, or self-adjusting scythe."—150 Prov. Reg.
— 2818. Hyam Hyams, Cornhill,—"Traveller's indispensable."—146 Prov. Reg.
— 2819. Hyam Hyams, Cornhill,—"Object glass."—24 Prov. Reg.
— 2820. Charles Burton, Broadway-terrace, Camden-town,—"Infant perambulator (child's carriage.)"
— 2821. A. N. Dare, Piccadilly,—"Shirt collar."
17th, 2822. Fowler & Fry, Bristol,—"Scavenging cart."
22d, 2823. B. Hick & Son, Bolton,—"Combined steam generator, or steam-engine boiler."
23d, 2824. A. Lamb and J. White, Southampton,—"Life-boat."
— 2825. W. Haigh, Huddersfield,—"Cowmilker."
— 2826. Miller & Sons, Piccadilly,—"Railway lamp."
24th, 2827. J. Gray & Son, Edinburgh,—"Radiating and reflecting-shell stove."
26th, 2828. F. W. Exall, Walworth Common, and J. S. Harraway, New-cross, Old Kent-road,—"Spring handle cricket-bat."
May 27th, 2829. G. Young, Glasgow,—"Adjustable screw-key wrench or spanner."
28th, 2830. S. Jackson, Red Lion-street,—"Illuminated candle clock."
June 2d, 2831. W. J. & J. Garforth, Duckenfield,—"Steam-boiler or generator."
3d, 2832. J. Young, Wolverhampton,—"Sash axle-pulley."
4th, 2833. J. Steadman & Co., Bristol,—"Ventilating hat."
— 2834. A. Hurrock, Peterborough, and J. Slate, Islington,—"Glass frame for railway and other carriages."
5th, 2835. J. Tennant, Shields, Monkton, Ayrshire,—"Self-cleansing diamond-toothed wheel-grubber."
11th, 2836. Groucock, Copestake, Moore, & Co., Bow-churchyard,—"Stays for morning dresses."
— 2837. S. Cocker & Son, Sheffield,—"Centripetal fish-hook."
— 2838. J. Blackey, Halifax,—"Railway-ticket preserver."
— 2839. H. Hicks, Davies-street, Berkley-square,—"Hick's Otium saddle."
12th, 2840. W. G. Morton, Burnham, Bucks,—"Equilibrium lubricator."
— 2841. W. S. Adams, Haymarket,—"Tap."
— 2842. G. F. Eckstein, High Holborn,—"Kitchen range."
13th, 2843. R. W. Winfield, Birmingham,—"Chain."
— 2844. R. Best, Birmingham,—"Glass-holder nozzle for candle lamps."
— 2845. D. Collins, Oxford-street,—"Four-folding portmanteau."
— 2846. W. M. Mayes, Boston,—"Floor-ram."
17th, 2847. W. Elgood & Co., Leicester,—"Le Capot."
— 2848. J. Lee, Bread-street-hill,—"Life-preserving and swimming vest."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 16th May, to 18th June, 1851.

May 16th, 216. Mrs. Catherine Billamore, Weymouth-street, Portland-place,—"Invalid's chair."
23d, 217. E. Stone, Wellington-place, Margate,—"Portable revolving dust separator and stove-cleaners' companion."
24th, 218. J. Bevan, Lyndhurst-place, Deptford,—"Shirt."
26th, 219. W. Riddle, East Temple Chambers, Whitefriars,—"Corkscrew and wire-nippers."
— 220. W. Riddle, East Temple Chambers, Whitefriars,—"Handle to lid of metal jug."
— 221. W. Riddle, East Temple Chambers, Whitefriars,—"Shower-bath."
— 222. W. Riddle, East Temple Chambers, Whitefriars,—"Apparatus for heating curling-irons by gas."
— 223. W. Riddle, East Temple Chambers, Whitefriars,—"Suspensory hospital couch."
— 224. W. Riddle, East Temple Chambers, Whitefriars,—"Looking-glass stand."
— 225. W. Riddle, East Temple Chambers, Whitefriars,—"Reading easel."
— 226. W. Riddle, East Temple Chambers, Whitefriars,—"Jar to be closed, sealed by mercury."
— 227. W. Riddle, East Temple Chambers, Whitefriars,—"Can for the conveyance of milk by railway."
June 2d, 228. W. Eades, Jun., Birmingham,—"Screw-stock."
— 229. L. Gaviolo, Hunter-street, Brunswick-square,—"Pendulum escapement for a clock."
— 230. L. Gaviolo, Hunter-street, Brunswick-square,—"Chronometer escapement."
— 231. S. Dumoulin, Paris,—"A corset without gusset."
— 232. T. Dossetor, Poultry,—"The epaulette brace."
— 233. W. Wade, Sunderland,—"Stirrup bridge for lady's saddle."
— 234. R. M. Nunn, Wexford, Ireland,—"Hydrometer."
3d, 235. H. Miles, Hackney,—"Combined loo-table and safe."
— 236. R. A. Peacock, Slyne Lodge, near Lancaster,—"New configuration or design for the construction of culverts for railways and other engineering works, and more especially for sewers for the drainage of cities, towns, and other places and districts."
5th, 237. W. E. Wilson, Birmingham,—"Grease cock."
11th, 238. J. Terry and T. Powell, Birmingham,—"Rotary action safety-lock."
— 239. S. Plimsoll, Sheffield,—"Exterior corner file."
— 240. S. Plimsoll, Sheffield,—"Interior corner file."
— 241. S. Plimsoll, Sheffield,—"Convex file."
— 242. S. Plimsoll, Sheffield,—"Concave file."
— 243. S. Plimsoll, Sheffield,—"Moulding file."
— 244. Bloomer and Phillips, Sheffield,—"Spring and lever brace-pad."
— 245. J. Cooper, Towerhead, Somerset,—"Compound geometric and spiral chuck."
12th, 246. A. Saxon, Middleton,—"Throstle bobbin."
— 247. J. Harding, Exeter,—"Safety bracelet."
— 248. J. Harding, Exeter,—"Double or safety snap."
13th, 249. J. Mason, Brompton,—"Shirt."
16th, 250. R. A. Peacock, Slyne Lodge, near Lancaster,—"Culvert for railways and other engineering works, more especially for sewers for the drainage of cities, towns, and other places and districts."
18th, 251. L. Hicks, Briggate, Leeds,—"Elastic ribbed waistband for drawers."

TO READERS AND CORRESPONDENTS.

RECEIVED.—"The Albert Window," by Isaac Farrell.

"Appleton's Mechanics' Magazine."—We have received from America, duplicate copies of No. 4 of this serial—the sender of which, in defiance of the new warrant as to the transmission of printed works, has put us to the expense of 1s. 8d. for carriage thereof. The number contains sixty-four octavo pages, about ten of which are original, the remaining fifty-four being reprints from various British works. To this mass of copied matter, the *Practical Mechanic's Journal* has been made to contribute very liberally, but, we regret to add, without the slightest acknowledgment of its services.

T. W., Haddington.—He may obtain any part or volume at 20 St. Andrew Square, Edinburgh.

H. W. H.—The plate in question is drawn to a scale, as, in fact, are the whole of our illustrations. In this case, the drawing does not refer to any particular example, so that the scale is not essential.

See "Pugin on Gothic Architecture."—We have already acceded to one portion of his third request; we may, perhaps, soon be enabled to attend to the others.

LISBON.—The matters he mentions would be very interesting. We shall look out for them. How will a letter reach him?

J. B.—His differential or equilibrium safety-valve is not new, but we shall probably find room for his suggestions next month.

WHAT IS THE GREAT EXHIBITION LIKELY TO EFFECT?

What is it not likely to effect? would be the question of many; and not confined to those only who regard with interest the material display before them. Bright hopes of brighter things beam upon the mind's eye, as it congregates within the sphere of its vision the examples of successful exercise of moral force which the scattered nations of the earth have contributed to this *cosmos* of human industry. These hopes have no where been more truly figured forth than in the Queen's answer to the Report of the Royal Incorporated Commissioners on the "glorious first of *May*." Her Majesty expressed herself as cordially concurring in the prayer that the undertaking might conduce to the welfare of her people, and to the common interests of the human race, by encouraging the arts of peace and industry, strengthening the bonds of union among the nations of the earth, and promoting a friendly and honourable rivalry in the useful exercise of those faculties which have been conferred by a beneficial Providence for the good and the happiness of mankind. A part of one of the mottoes on the title-page of the shilling catalogue—and all of which, to no disadvantage of his Royal Highness Prince Albert, it may be repeated, were selected by him—points significatively to the grand end, and the means of attaining it. "The progress of the human race," runs the translation, "resulting from the common labour of all men, ought to be the final object of each individual." The collector of ancient art has sufficiently demonstrated in his museum-teachings, that this progress is not chained down to mere increase of physical agents operating to the comfort or lower delectation of man; but, from compelling us to be conscious, in many of these matters, of being ourselves far behind the early artist, we are enforced to acknowledge that, if there be such a living state of things as *progress* at all, we are not to be over-solicitous in looking for it in the forms of matter, but in those more subtle principles and energies of which those forms are demonstrations, as simple as is a printed page to the thought conveyed through its instrumentality from one mind to another.

Towards this, what is the Exhibition likely to effect? The first conception of it was worthy of the first gentleman in the world, and could have arisen only in a mind carefully self-nurtured. What it really was, however, is best now seen in the promptitude with which the idea may be said to have flooded the nations, and the continued life it has derived from its own vigorous constitution—child, as it is, of the strength of Time. Every one experiences that his imagination is never satisfied with its own demonstrations. They are always comparatively feeble, and many, besides the great Latin poet, would, upon review, thrust their best perfected Æneids into the fire. Thus it is possible that the Prince Consort, among the millions who will see the Exhibition, may be the only person to whose eye its splendours appear dull. It is not so, however, to those to whom the Exhibition—although coming, as it were, at second hand—operates in itself as an exciting power. How manifold is its influence in this respect, it is really singular to witness. Stationed for a time in London, and observing with no slight attention and interest the feelings of many classes of the community, we were struck with the extraordinary excitement which prevailed among all with regard to it from the peer to the mechanic. There can be no doubt that the press has mainly contributed to this; but, from whatever cause it has arisen, the effect remains the same; and it must be confessed that the Exhibition is enjoying the full and wide current of popular esteem. A general stimulus of this kind is no indifferent thing: anything that any way arouses attention, also, if properly considered, suggests action; nay, in some directions, enforces it. The increased power thus generated must live its life in some forms of liberty or law. It is never born dead.

Such an extent of excitement, the world has never before experienced. The flame of the Crusades lighted up Europe only. The comparatively small instances which fired the British mind during the great mammon huntings in the South Sea scheme, and in the recent Railway speculations, are well characterised by the term "mania," which has been applied to them. The total non-application of such a term to that feeling which is kindled by the sight and thought of the Great Exhibition, serves to depict it with greater truth, by pointing to a progression which, in the history of man's affairs, is as new as it is substantial—a step made—another increased volume of power attained, and we feel certain that there cannot be any matter of analogous calibre for years, perhaps centuries, to come.

On this theme, however, it is not our purpose now to dwell. The daily, weekly, and monthly press re-echoes with it. Our very shops are already beginning to show what effect it has had even in the cellar and the garret of the artisan; and it is reasonable to conclude, as a completely established point, that the eye of the least thoughtful, educated by it, will no longer be satisfied with any but forms of loveliness and beauty, or of usefulness and truth. Thus will the Exhibition turn out a great teacher, as well as a great excitant; these two offices ever accompanying an approved leader in the quiet battle of the world against ignorance, and the thousand horrible things sliming in its train.

What zest may be afforded by the realization, in the eyes of the multitude, of the Prince's idea, may, in some measure, be estimated by the quantity of industrial power which it will for ever henceforth disabuse of conventional exercise in *worn-out usefulness.* Two facts occur to us at the present moment, which point to this conclusion. We mean (1.) The almost total absence of interest exhibited by the sight-seer of all classes in engines of destructiveness, from the tiny pistolet, that does not weigh one grain, to the new revolving barrelled weapon, which the ingenuity of a United Statesman has contributed. (2.) The almost universal feeling and expression of disappointment experienced after sight of those articles for personal decoration, the fame of which, of all things, first attracted the eye, viz., jewels, from "the unique blue diamond" belonging to Mr. Hope, to "the mountain" and "the sea" of light, the mighty and trumpery gem-symbols in our land of bloody and plundering war—very knaves of diamonds, as our friend *Punch* says.

We think there is somewhat not unpleasant in this. The Exhibition has served as an *experimentum crucis* on the substantial thoughts of the present human mass; and it has proved that the reflective community are averse to war, and indifferent to the other pleasures accompanying barbarism, wherever it existed, or wherever it exists. Of such pleasures not the least are those which attract the imagination, and attract it with the greater force as it is the more enfeebled. Hence is it that the Caucasian races, however greatly they may still indulge in such pleasure, do so in a far less degree than do the other portion of mankind. From all ages, the East particularly has been most distinguished for a love of finery, and, except in rare instances, has been the least famed for stepping-places it has gained in the history, and for the benefit of general man. The Exhibition itself affords abundant proof of this, by demonstrating that length of time, other things being equal, by an almost appreciable law, ministers to higher results; and we may read, in the gorgeous *elephant* trappings—which an eastern nabob has recently sent as a present to the Queen, and which her Majesty has kindly permitted to be exposed to public view—the very low state of civilization which exists in the great bulk of the Indian community. Attracted by, and delighting in, such matters, the mental power not so much finds no pleasure, as is deficient in calibre to rejoice in the quiet prosecution of *more generally useful* industry. A something like a light, by some means or other, is kindled in the nation, and the inhabitants circle around it and around it to their perpetual danger and loss; all the energies lie prostrated before it, showing fearful signs of the moral death in which they are involved. Hence it is that the plough and the loom of India—the two prime types of all useful toil—are, at the present hour, observed to be of the same form as our ancestors have told us they were centuries ago. All is stagnant, except when the stimulant appears to the sensuous eye or ear in the glit-

ter of silver, and gold, and gems, on or immediately surrounding the person of the combined legislature and executive.

This is not the case with the more civilized Caucasian races. With them the stimulus to labour is largely from within. Hence all progress—all great and noble things—hence the Royal Exhibition itself. All honour to inventors! The turn of the world's scale is with them—the lever which Archimedes required to move the earth is in their patient thoughts and bold enterprise. Unattracted by mere novelty, as well as unscared by it, they wait quietly and consider; and so soon as the mathematical and logical formulæ, which, in greater or less extent, accompanies every form of contrivance, are completed, the hand is ready to minister to the realization of the idea; before idleness or indolence has awakened, the work is accomplished, and the left hand is in the prospect of a still busy future, unsolicitous of knowing what the right hand has done.

It is this energy, having a wholesome life, which rejects all appearances of destructiveness, all exhibitions of mere *standing-stillness.* It is never satisfied but when it is in motion, and in more and more progressive motion. When it looks, it *examines;* as it examines, it improves. It has "the better" constantly before, and is ever striving after the best. It alone appreciates the advantages of combination, and also of division of labour; knowing, in the former, the end it would arrive at, and, in the latter, the means of attaining such end. It is always too busy to be unhappy; and if mischance arrives, and even errors—as they will do—it wastes no hours in depressing grief at former failure, but, too conscious of duty, makes even disappointment a way to brighter hope, and more strenuous and careful exertion, which it feels certain will, in due time, be crowned with a better thing than a splendid tiara—namely, with substantial rejoicing.

It is the stimulus given to this energy which we see is one of the great things which the Exhibition will produce; and another, and as high a matter, will be the direction of the force it thus calls into action. This direction can never be backward with those who think. Onward is its certain course.

To make one other happy for a day is no mean achievement. Prince Albert must certainly feel the delight of making fifties of thousands happy for months. When we contemplate the eye reading the real lesson before it, and the ear hearing the sound like that of fertilizing waters around it, and fancy, as the most sedate and prosy, in this day, is compelled to fancy, the actual presence of the future, we can ourselves see and hear millions of our race rejoicing; many, indeed, passing on in a current of rejoicing, which had its initiative in a sight-seeing and something-new-learning-day at the Great Exhibition. We see them wonder that we should not long since have known, and acted upon the knowledge of the truths taught by the sages of old, that "wisdom is better than weapons of war," and "the exchange of it shall not be for jewels of fine gold."

AULD'S IMPROVED STEAM MACHINERY.

FEED APPARATUS FOR STEAM BOILERS—SELF-REGULATOR FOR OBTAINING LOW-PRESSURE STEAM FROM A HIGH-PRESSURE BOILER—DIRECT STEAM ACTION FOR REGULATING EXPANSION VALVES FROM THE GOVERNOR.

(*Illustrated by Plate* 75.)

The improvements in steam machinery, delineated in plate 75, illustrate three arrangements of apparatus, comprehended, with several others, under a patent recently obtained by Mr. David Auld, of Glasgow. The invention in question relates:—

1. To certain means for supplying boilers with water—the economic regulation of such supply, and the adjustment of the damper.

2. To apparatus for the self-acting, reduction, or regulation of the steam pressure in boilers, whereby low-pressure steam may be drawn off from a boiler working at a higher pressure, so that high and low pressure engines or machinery may be worked from one boiler.

3. To a peculiar form or arrangement of furnace for preventing the formation of smoke.

4. To a mode of actuating expansion valves in connection with the governor, wherein the latter adjusts the degree of expansion through the intervention of a steam cylinder and piston.

In the two first modifications of his apparatus, the patentee shows how a series or range of boilers may be all governed in their water-supply by a single float-regulator, working in connection with a continuous horizontal feed-pipe, having a branch to each boiler. The regulating float is contained in a "steam and water chamber," the rise and fall of the fluid level in which actuates an equilibrium valve on the pipe leading from the force-pump, or source of supply. When the float falls from the lowering of the water-level, this valve opens and admits water to the boiler. When, on the contrary, the water-level rises, the float closes the valve, and the water from the feed-pump is then passed off through a loaded valve between the pump and equilibrium valve. By another arrangement, the fall of the float closes the equilibrium valve, and the feed-water having then no other means of exit, passes directly into the boiler through a clack-valve. The rise of the float again opens the equilibrium valve, and the surplus feed passes out through an escape branch on the valve-chest, instead of overcoming the steam pressure and passing into the boiler. In this arrangement, the loaded discharge valve is unnecessary, and the feed-pump is relieved from all opposing pressure whenever the water-level in the boiler rises to its proper height. The invention also shows a simple and ingenious mode of regulating the feed action of the supplying pump, by connecting the regulating float with a branch opening into the pump-barrel between the inlet and outlet clacks. In this plan, the fall of the float is made to open a valve on this branch so as to admit air or water between the two clacks, and thus vitiate the pump action, and prevent it from giving a full supply to the boiler.

Fig. 1 on our plate exhibits another form of improved feed apparatus for steam-boilers, wherein the ordinary elevated feed-pipe, as applied to low-pressure boilers, in existing arrangements is used. In this arrangement, a single feed-pipe answers for the regulation of the water-supply of any number of boilers in a range, and admits of the combined action of the entire series upon a single regulating float for actuating the damper. In this figure is delineated a set of four boilers, A A A, of a range, connected by their overhead main steam-pipe, B, and having a continuous horizontal feed-pipe, C, traversing along their front ends. The four boilers are represented in external elevation, whilst the whole of the feed apparatus is in vertical section. The vertical feed-pipe, the ascent or descent of the water column in which regulates the damper of the boiler-flues, is at D, its lower end opening at E into the horizontal pipe, C. In this way the vertical pipe, D, is in communication with the entire range of boilers—any variations in the steam pressure in which causes a corresponding variation in the height of the water column, thus raising or lowering the balanced float, F, and adjusting the damper accordingly; so that each individual boiler exercises its own due effect upon the damper in combination with the rest of the series. The supply of water through the vertical pipe, D, is adjusted by the steam and water chamber, G, which has a branch steam-pipe, H, opening into the main pipe, B, whilst its lower end is in connection with the horizontal feed water-pipe, C, by the branch at I. The working water-level of the boilers is represented by dotted lines at J J J; and as the pressure of the steam in the upper portion of the chest, G, balances the pressure arising from the water in the lower portion, the water stands at the same level in the chest as in the series of boilers. Then, as this level varies, the rise or fall of the float, K, in the chest, acts through the rod, L, upon the lever, M, which is carried on a fixed centre, N, on the top of the small receiver, O, surmounting the vertical pipe, D. The opposite arm of this lever is linked at P to a small conical valve, Q, in the seat of the receiver, so that, as the water-level falls in the chest, G, the descent of the float elevates the valve, Q, and admits water from the receiver to the vertical pipe, D, for the supply of the boilers through the pipe, C. In the drawing, the water-supply is supposed to be delivered to the receiver, O, by the branch, R, whilst the surplus flows off by the opposite branch, S. Instead of the steam and water chamber, G, a regulating float may be placed in one or more of the boilers, and arranged to act upon the valve, Q.

Fig. 2 represents the duplex pressure-regulating apparatus. In this view, a boiler is represented in transverse or end section, with the adjusting apparatus for the steam pressure partly in vertical section. A, Is the boiler, which we may suppose to be working at a pressure very considerably higher than that at which it is intended to draw off steam for another purpose. The main steam-pipe for conducting the ordinary high-pressure steam to the engine or machinery is at B, the flow being governed by a stop-valve, C. At the opposite side of the chest in which the stop-valve is contained, is a smaller steam-pipe, D, governed by a sluice-valve, E, and extended onwards as at F. At G, is a steam and water chamber, from the top of which a branch steam-pipe, H, opens into the extension of the steam-pipe, F, through the chest, I, of a loaded valve

M MACHINERY.

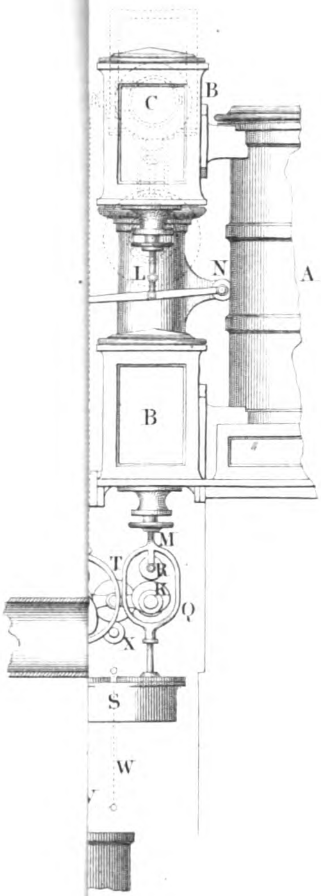


Fig. 4.

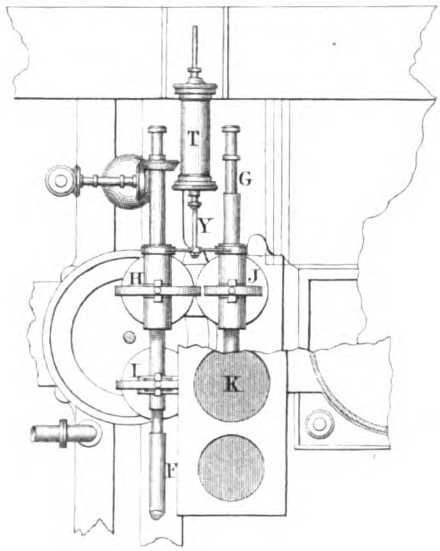
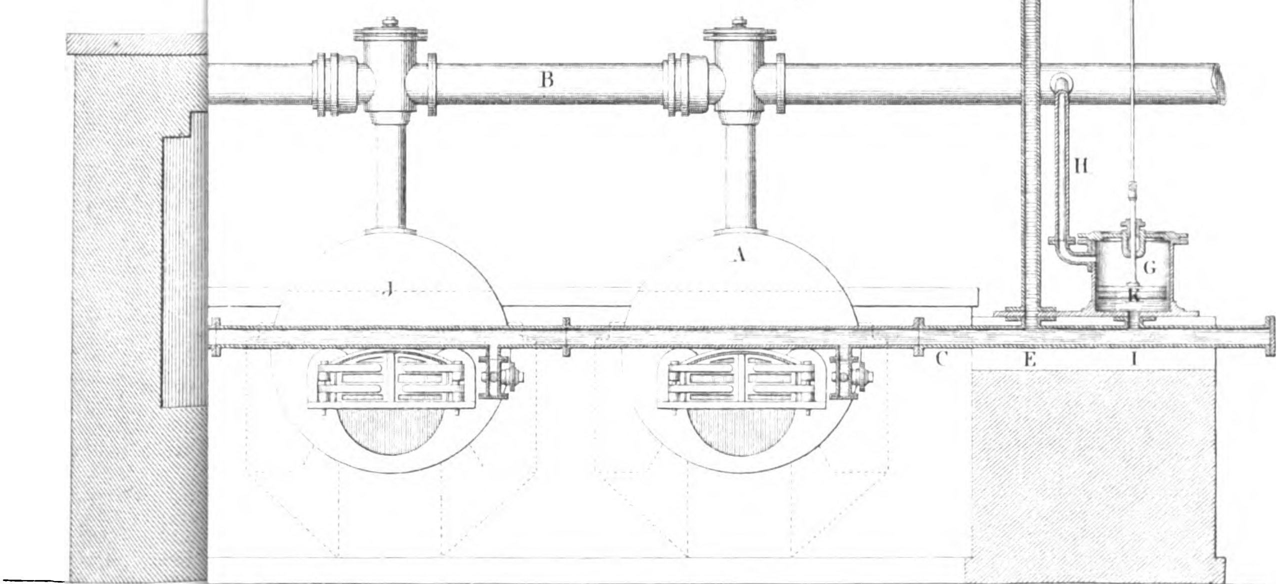


Fig. 1.



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set on the upper side of the pipe, F. The lower part of the chest, G, is occupied by water, into which the open lower end of a vertical pipe, J, is made to dip, after passing through the cover of the chamber. The steam from the pipe, F, passing through the valve-chest, I, and branch, H, presses upon the surface of the water in the chamber, G, and elevates a water column in the pipe, J, to a height corresponding to the steam pressure. In the pipe, J, is a float, K, a chain from which passes over the fixed guide-pulley, L, and descends to the segmental lever, M, to which it is attached. This lever, M, is fast on the spindle of the steam-regulating valve, N, placed in the pipe, F, immediately behind the valve, E. The effect of this arrangement is, that steam from the high-pressure boiler, passing along the pipe, D F, elevates the loaded valve in the chest, I, and entering the chamber, G, elevates a water column in the pipe, J, and with it the float, K, producing a partial closing of the valve, N, in the steam-pipe, D F, and thus reduces the steam pressure in the extension of the pipe, F, whence it may be drawn off for use.

In putting an apparatus of this class into action, the valve in the chest, I, is loaded with a weight somewhat less than that necessary to keep the valve closed against the pressure of the required low-pressure steam; and the slight elevation of the column of water in the pipe, J, produced by the escape of steam through this valve, then actuates the regulating valve, N, adjusting the thoroughfare for the passage of the high-pressure steam through it, to bring down the pressure in the pipe beyond this valve to the point required. Thus, whilst the steam pressure on the side of the valve, N, next the boiler, remains at its initial height, that on the other side of the valve in the extension of the pipe, F, is reduced accordingly as this valve, N, is set to give a large or small thoroughfare, with a given height of water column in the pipe, J. It is obvious that the weight upon the loaded valve in the chest, I, may be any weight less than that which would entirely prevent any escape of the steam through the valve; the office of this valve being simply to allow as much steam to pass as will elevate a short column of water in the pipe, J, the actual regulation of the low-pressure discharge being effected entirely by the setting of the valve, N. Thus, in practice, it will be found that the weight per square inch upon the loaded valve must be slightly less than the pressure at which it is desired to draw off low-pressure steam from the pipe, F.

By slight modifications of this arrangement, the vertical pipe, J, and water column, as well as the loaded valve of the chest, I, may all be dispensed with. According to one of these plans, a small steam cylinder, with a piston, may be fitted upon the low-pressure steam-pipe, such piston being weighted or held down by a spring, and made to work in connection with the regulating valve, N. By this mode, the rise or fall of the piston will correspondingly affect the regulating valve, and open it only so far as to admit steam to pass at the reduced pressure required. Or, instead of this arrangement of cylinder and piston, a chest may be fitted upon the low-pressure steam-pipe, F, and having within it a weighted disc or diaphragm of some elastic material. The underside of this elastic diaphragm being open to the steam-pressure beneath, the material will be expanded or pressed upwards in a degree corresponding with the actual pressure exerted. The movement of the diaphragm, thus produced, may be communicated to the regulating valve, N, by a rod or plunger on the upper side of the disc, so as to open or close the valve as may be necessary for the desired low pressure. This power of withdrawing steam from a boiler at any given variable pressure, may be turned to considerable advantage in various manufacturing processes, where several pressures may be required. Or the same system may be adopted in working steam-engines or machinery, so that one engine or machine may be worked by a high pressure, and another by a low pressure, from the same boiler.

Fig. 3 represents a side elevation of a portion of a steam-engine, and fig. 4 is a corresponding plan, showing Mr. Auld's plan for varying the expansive action from the governor. In these views a portion of the steam cylinder is delineated at A, having the ordinary nozzles, B B, attached. The steam is supplied by the pipe, C, where a common throttle valve, D, is fitted, being worked from the upper ring, E, of the governor. In this arrangement the nozzles contain four conical lift valves, one for the admission and one for the exhaust action of the steam, at each end of the cylinder.

The positions of these four valves are represented by the circles in the plan, the whole set being worked from the two horizontal revolving shafts, F G, each of which carries two cams, H I and J K, for this purpose, the two cams, J and K, work the exhaust valves for the top and bottom of the cylinder respectively. These are subject to no alteration, as they are set to retain their valves constantly open throughout the respective exhaust strokes. The other two cams, H and I, are constructed with their eccentric prominences set spirally in reference to their shafts; or, in other terms, they resemble flat wedges wound upon a cylinder, so that, by traversing them longitudinally upon their shafts, they are caused to keep their valves open for a longer or shorter time, according to the motion given to them. Each cam is adjusted upon a fixed feather in its shaft, so that it may traverse longitudinally whilst it is carried round on the shaft. The spindles of the two steam-admission valves are at L M. That for the upper valve, marked L, is linked to a lever oscillating on a fixed centre at N, the opposite end of the lever being connected to the link-rod, O, passing downwards to the actuating cam, H, and having at its lower end an open frame-piece, P, in which the cam works in giving motion to the valve. The spindle, M, of the lower steam-admission valve has its frame, Q, for the cam formed upon it, and passes directly from the cam to the valve. As the cams revolve, their eccentric sides, acting against the antifriction pulleys, R R, in the upper sides of their frames, lift the valves for the admission of steam to the cylinder, the valves falling down by their own weight to close the ports when released from the cam action; or they may be drawn back in the manner represented at S, where each cam-frame has a projecting spindle, having attached to it a small piston working in a water cylinder, the action of the apparatus being very similar to that of the "cataract," as employed in pumping, and well understood by practical men. The requisite longitudinal movement of the cams for varying the deviation of the opening of the valves, and consequently the degree of expansion, is obtained from the small horizontal steam cylinder, T, the action of which again is regulated by the governor's lower sliding-ring, U. This ring is connected by the shafts and links, V W, with the steam-admission valve, X, at the bottom of the cylinder, T, so that, as the ring slides up or dôwn, from any variations in the speed of the engine, it actuates the valve, X, and admits steam to one or other end of the cylinder, accordingly as it may be set. Or, instead of using steam to move the piston, the cylinder may be connected with the condenser, so as to take advantage of the atmospheric pressure to shift the cams. The piston-rod, Y, of the cylinder, has upon its end a short cross-head attached by a pair of collars to ring-grooves in the ends of the cams, H and J. In this way, when a variation in the rate of the engine causes steam to be admitted behind or beneath the piston of the cylinder, T, the consequent traverse of the piston causes a corresponding traverse of the cams for the alteration of the degree of expansion, in the manner which I have already described.

By this arrangement, the rate of the engine is made, through the medium of the governor, to be the means of accurately regulating the amount of expansion, whilst the employment of the actuating steam cylinder for the traverse of the cams affords a varying action, much quicker and more certain and effective than that attainable by ordinary modes now in use.

For the better combustion of the gaseous products of fuel in steam-boiler furnaces, the patentee proposes to place what he terms "separating and combining surfaces" inside the flue, for the better commingling of the gaseous current. A short division is built in the centre, with expanding wings so placed as to cause the gases to be deflected outwards in two currents, which are afterwards re-deflected by suitable stops placed behind the first division. The fuel is supplied to the furnace through a hopper, or receiver, having a regulating bottom door. As it falls in a heap on the front plate of the furnace, it is, from time to time, pushed forward upon the bars by rods passed through holes in the furnace doors.

GENERAL VIEW OF GEOMETRY.

I.

The common definition of geometry, as the *science of extension*, is not only vague, but quite erroneous. We might amend this definition at once, by saying that the object of geometry is the *measurement* of extension. But such a definition would of itself convey little information, although substantially correct, its fault being that it affords no explanation as to the general character of geometrical science.

With this end in view, I shall first refer to two fundamental conceptions, which, though very simple in themselves, have been singularly obscured by metaphysical reasonings.

The first is that of *space*, from which so many sophistical reasonings have sprung, and which has given rise to so many useless and trifling discussions amongst the metaphysicians. Reduced to its actual meaning, the conception is simply this, that in place of considering the extension of bodies themselves, we survey them in an indefinite medium, which, we believe, contains all the bodies of the universe. The notion is naturally suggested when we reflect upon the impression or cast which a body placed in a fluid would make. Such a cast, it is evident, may, for the purpose of geometrical reasoning, be substituted for the body itself. As to the nature of this indefinite *space*, we instinctively represent it as analogous to the medium by which we are surrounded, so that

if this medium were a liquid, in place of being gaseous, our geometrical space would, in all probability, be considered as a liquid. This, however, is quite a secondary circumstance, for the essential object of the conception is solely to make us contemplate extension as something different from the bodies by which it is manifested. It is easy to comprehend, *à priori*, the importance of this fundamental conception, since it permits us to study geometrical phenomena in themselves, apart from all the other irrelevant phenomena which constantly accompany bodies. The establishment of this general conception must be regarded as the first step in the study of geometry—a study which had been impossible to us, if it had been necessary to consider the whole of the physical properties of bodies along with their form and magnitude. This hypothesis, which is perhaps the oldest philosophical conception framed by human art, has become so familiar to us, that we have difficulty in measuring its real importance, and conjecturing the consequences that would flow from its suppression.

Geometrical speculations being thus rendered abstract, they have acquired not only more simplicity, but more generality. As long as space is invariably considered with reference to existing bodies, there can be no investigation as to forms, except those actually realised by nature, and this would very much curtail the field of the science. On the other hand, by conceiving extension in *space*, the mind can contemplate every imaginable form whatever, and this is indispensable for obtaining for geometry a character completely philosophical.

The second geometrical conception which I shall examine, is that which refers to the notions termed *volume*, *surface*, *line*, and *point*, the ordinary explanation of which is so little satisfactory.

Although it is evidently impossible to conceive any degree of extension absolutely without some one of the three fundamental dimensions, it is no less incontestable that geometrical questions frequently depend upon only two dimensions, considered apart from the third, or of a single dimension, considered apart from the two others. Before we can study the geometry of real bodies—that is to say, bodies possessing the three dimensions of space, the direct theory of which would be too complex—we must first master the geometrical laws appertaining to space having only one dimension, and then to that which has only two dimensions.

It is with the view of permanently contemplating extension in one or two directions only, that the mind has formed the general notions of surface and line. The hyperbolical expressions employed by geometers to defend them, have a tendency to diffuse false ideas regarding them. But, examined in themselves, they have no other aim than to permit us to reason readily about these two kinds of extension, by withdrawing the properties to which they relate from those which ought to be taken into consideration. Now, to that end, it is sufficient to conceive the dimensions that we would eliminate as becoming gradually less and less, the others remaining constant, until it is reduced to such a degree of tenuity that it need no longer be taken into account. It is thus that we acquire the idea of a surface of a line, and by a second analogous operation, doing with respect to breadth what we had previously done with regard to thickness. Finally, if we again repeat the process, we arrive at the idea of a point, or of space considered solely with reference to its place (magnitude of every kind being abstracted), and intended therefore to denote position merely. Surfaces have the general property of accurately circumscribing volumes; whilst lines, in their turn, circumscribe surfaces, and are limited by points. But this consideration, to which too much importance is frequently given, is only a secondary matter.

Lines and surfaces are therefore really conceived with three dimensions; it would, in fact, be impossible to represent a surface otherwise than as an extremely thin sheet, and a line than as a thread infinitely fine. It is evident that the degree of tenuity attributed by each person to the dimensions which he desires to conceive is not precisely identical, since it will depend upon the degree of the delicacy of his habitual geometrical observations. This want of uniformity, however, carries no actual inconvenience with it, because it is sufficient, in order that the conceptions of surfaces and lines should fulfil the essential condition of their destination, that each represents the dimensions to be neglected as smaller than all those of which his daily experience gives him any cognizance.

Let us now proceed to consider that definition of geometry which describes the science as having the *measurement* of extension for its final aim.

And first, we must premise that the notion of measurement is not exactly the same with reference to surfaces and volumes as it is to lines. For if we take the word *measurement* in its direct and general mathematical acceptation, as simply signifying the valuation of ratios borne by homogeneous magnitudes to one another, we must consider that in geometry the measure of surfaces and volumes, as distinct from that of lines, is never conceived even in the simplest and most favourable cases as being immediately effected. The comparison of two lines is regarded as direct; that of two surfaces or two volumes, on the contrary, is constantly indirect. Two lines may be readily conceived as superposed; but the superposition of two surfaces, and, *à fortiori*, that of two volumes, is evidently impossible to establish in the great majority of cases; and even when it is actually practicable, such a mode of comparison is neither convenient nor susceptible of accuracy. It is therefore necessary to explain in what the geometrical measurement of a surface or a volume properly consists.

For this purpose we must consider, that whatever be the form of a body, there always exists a certain number of lines more or less easy to assign, the length of which is sufficient to define exactly the magnitude of its surface or of its volume. Geometry, regarding these lines as alone susceptible of being directly measured, proposes to obtain from their simple determination the ratio of the surface or volume sought for, to the unity of surface or the unity of volume. Thus the general object of geometry, in regard to surfaces and volumes, is really to reduce all comparisons of surfaces and volumes to simple comparisons of lines.

Besides the facility which such a transformation evidently affords for the measurement of volumes and surfaces, we shall find, on examining the matter more closely, that there is a possibility of reducing to problems of lines all the problems relative to volumes and surfaces, considered with respect to their magnitude. Such is often the most important use of those geometrical expressions which represent surfaces and volumes as functions of lines.

I do not mean to say, that direct comparisons between surfaces or between volumes are never made. But such measurements are not regarded as geometrical, and they are only looked upon as expedients called for, although too rarely practicable, by reason of the insufficiency or the difficulty of scientific processes. For example, we frequently determine the volume of a body, and in certain cases its surface, from its weight. When it is possible to substitute an equivalent liquid volume for the given volume, we are able to compare two volumes directly, by taking advantage of the property which liquid masses possess of taking any form which we may choose to give them. But all means of this nature are purely mechanical, and pure geometry necessarily rejects them.

In order to render more sensible the difference between these determinations and true geometrical admeasurements, I shall cite one very remarkable instance—the mode in which Galileo valued the ratio of the ordinary cycloid to that of the generating circle. The geometry of his time being still insufficient for the solution of such a problem, Galileo took the course of ascertaining the ratio by experiment. Having very exactly weighed two sheets of the same substance, of equal thickness, whereof one was shaped as a circle, and the other as the engendered cycloid, he found the weight of the latter invariably three times greater than that of the first; whence he concluded that the area of the cycloid is triple that of the generating circle—a result afterwards confirmed by Pascal and Wallis by geometrical processes. So successful a result was evidently owing to the extreme simplicity of the ratio sought for; and we can easily conceive the insufficiency of similar expedients, even when they are capable of being put into execution.

After what we have said, we see clearly of what that part of geometry connected with volumes, and that part connected with surfaces, really consist. But we do not yet see so clearly the character of the geometry of lines, because, in order to simplify the exposition, we have supposed lines to be susceptible of direct measurement. There needs, therefore, a word of explanation.

To this end we must distinguish between right lines and curves, the measurement of the first being alone regarded as direct, and that of the others as invariably indirect. Although superposition is sometimes quite practicable in the case of curved lines, it is evident, nevertheless, that pure geometry must reject such a process as not admitting, even where possible, of any accuracy. The geometry of lines has therefore for its general aim, the measurement of curves by means of right lines; and consequently, under a more extensive point of view, the reduction of all problems connected with the magnitude of any curves whatsoever, to simple questions of right lines. In order to comprehend the possibility of such a transformation, it is necessary to remark, that in all curves whatsoever there invariably exist certain right lines, the length of which is sufficient to determine that of the curve. Thus, in a circle, it is plain that we are able to obtain the length of the circumference from that of the radius; again, the length of an ellipse depends upon that of its two axes, the length of a cycloid from the diameter of the generating circle, &c.; and if, instead of considering a curve in its entire dimensions, we seek for the length of some arc, it will suffice to add to the different rectilineal parameters which determine the whole curve, the cord of the required arc, or the co-ordinates of its extremities. To discover the rela-

tion existing between the length of a curve and that of similar right lines, such is the general problem which we have essentially in view in that part of geometry connected with lines.

By combining this consideration with those heretofore given in reference to volumes and surfaces, we may form a well-defined idea of geometrical science, taken as a whole, by assigning, as its general aim and last result, the reduction of the comparisons of all kinds of extension, volumes, surfaces, or lines, to simple comparisons of right lines—right lines alone being regarded as susceptible of direct comparison. And although such a conception comprehends the true character of geometry, it seems to be advisable that we should show its utility and perfection from one single point of view.

In order to render this account complete, there remains to explain how it happens that there is a special section devoted to the right line, since this appears incompatible with the principle, that the measurement of this species of line should be always regarded as direct.

It is so, in fact, with reference to the measurement of curves, and of all the other objects considered by geometry. But it is evident that the valuation of a right line can only be looked upon as direct, in so far as we can directly compare it with the linear unity. Now, in most cases, such an operation is prevented by insurmountable difficulties, and our only course is to connect it with other analogous measurements capable of being directly effected. There is therefore, of necessity, a distinct preliminary section entirely devoted to the study of the right line. Its object is to determine some right lines by means of others, according to the peculiar relations of the figures resulting from their combination. This preliminary section, which is almost invisible when we contemplate the science as a whole, is nevertheless susceptible of great development; and its importance is evident, when we consider that all geometrical measurements have to be connected, as far as possible, with that of right lines, and that the impossibility of determining these last would render incomplete the solution of every question whatever.

Such, then, are the different fundamental parts of scientific geometry, according to their natural dependence; and it is clear, that if we would study it in a really systematic manner, we must first consider the geometry of lines, beginning with the right line, and then pass to the geometry of surfaces, and afterwards to that of volumes.

Having, then, determined the general object of geometrical investigations, we must now consider the science in relation to the field embraced by each of its three principal sections.

Thus contemplated, geometry is, by its nature, capable of an indefinite extension, for the measurement of lines, surfaces, or volumes, necessarily presents as many distinct questions as we can conceive different forms subjected to exact definition, and the number of them is evidently infinite.

Geometers were at first limited to the consideration of the simplest forms supplied by nature, or to the least complicated combinations of these primitive elements. But, since the time of Descartes, it has been felt that the science, to be truly philosophic, must be applied generally to all conceivable forms; in other words, that abstract geometry must comprehend, as particular cases, all the different forms presented by the external world. If we had had always to study these natural forms without being able to connect them with general principles, and without being prepared by the special examination of certain of the simpler hypothetical forms, it is clear that the difficulties would have been frequently insurmountable. The necessity of considering, as far as possible, all conceivable forms, is therefore a fundamental principle of geometry when truly scientific. A slight examination suffices to show that these forms present an almost infinite variety. By regarding curves as engendered by the motion of a point subjected to a certain law, we shall have as many different curves as there are laws governing the motion, which motion may take place according to an infinity of distinct conditions, although it may accidentally occur sometimes that new motions generate curves already obtained. Thus, limiting ourselves to plane curves only, if a point moves so as to continue at the same distance from a fixed point, it will generate a circle; if it is the sum, or the difference of its distance from two fixed points, that remains the same, the curve described will be an ellipse or an hyperbola; if it is their product, we shall have a curve quite different; if the point moves always equally away from a fixed point and a right line, it will describe a parabola; if it revolves in a circle at the same time that the circle rolls along a right line, we shall have a cycloid; if it advances along a right line whilst the latter, being fixed at one of its extremities, revolves in any manner whatsoever, there will result what are called spirals, &c. &c. Each of these different curves will furnish new ones by the different general constructions which geometers have conceived, and which give rise to epicycloids, caustics, &c. Finally, there is a still greater variety amongst curves of double curvature.

As to surfaces, their forms are necessarily still more diverse, because we have to regard them as generated by the motions of lines. For not only will the form vary, as in curves, by reason of the different laws, in number infinite, to which the motion of the generating line can be subjected, but also by reason of the line itself changing its nature—a circumstance that has nothing analogous in the case of curves, the points which describe them having no distinct figure. Two species of conditions may therefore influence the forms of surfaces, whilst as to lines there is only one. It is useless to cite specially a series of examples to verify this multiplicity, infinite in two directions, which surfaces possess. It may suffice to consider the vast variety which the single group of surfaces, termed *ruled* (*reglées*), presents; that is, those generated by a right line, and which includes the whole family of cylindrical surfaces, that of conoidal surfaces, &c.

As to volumes, they do not call for any special remark, seeing that they are only distinguishable from one another by the surfaces which bound them.

In order to complete this view of geometry, it must be added, that surfaces themselves furnish a new general method of conceiving new curves, since every curve can be looked at as produced by the intersection of two surfaces. The first lines which may be considered as having been really discovered by geometers (since nature gives us everywhere the right line and the circle), were thus obtained. We know that the ellipse, the parabola, and the hyperbola, the only curves completely investigated by the ancients, were originally conceived as resulting solely from the intersection of a cone with a circular base, by a plane diversely situated. It is evident that, by the combined employment of these different general means for the formation of lines and surfaces, we might produce a really infinite series of distinct forms, setting off from a very small number of figures directly furnished by observation.

But all the different direct methods for the invention of forms have no longer scarcely any importance, since geometry assumed its definite character in the hands of Descartes. The invention of forms is nowadays reduced to the invention of equations; so that nothing is more easy than to conceive new lines and new surfaces, by changing at will the functions introduced into equations. This simple abstract process is infinitely more fruitful than the direct resources of geometry, developed by the most powerful imagination, applying itself solely to this order of conception. It explains, moreover, in a manner the most general and intelligible, the necessarily infinite variety of geometrical forms, corresponding thus to the diversity of analytical functions. Lastly, it shows not less clearly that the different forms of surfaces must be still more numerous than those of lines, because lines are represented, analytically, by equations of two variables, whilst surfaces give rise to equations with three variables, and therefore necessarily present a greater diversity.

The preceding considerations suffice to show distinctly, that each of the three great sections of geometry, respectively, relating to lines, surfaces, and volumes, is really of infinite extent—a result of the infinite variety of bodies to be measured.

In order to convey an exact and sufficiently extensive idea of the nature of geometrical investigations, we will now revert to the general definition hereinbefore given, with the intention of presenting it under a new point of view, without which the science would be but imperfectly conceived as a whole. By assigning as the object of geometry the measurement of all kinds of lines, surfaces, and volumes—that is, as I have already explained, the reduction of all geometrical comparisons to simple comparisons of right lines—we have evidently the advantage of marking out a very precise purpose, and one very easy to comprehend. But if, discarding all definitions, we attend only to the actual composition of geometrical science, we shall perceive that the preceding definition is much too narrow, for there can be no doubt that the greater part of the investigations, constituting geometrical science, appear to have no connection with the *measurement* of extension. It is probably such a consideration which retains these vague definitions for geometry—definitions which comprise everything, because they particularise nothing; nevertheless, I think I shall prove, in spite of this fundamental objection, that the *measurement* of extension may be indicated as the general and constant aim of geometrical science, and that everything which really enters into its composition is thereby embraced. In truth, if, instead of limiting ourselves to the isolated consideration of the different geometrical investigations, we endeavour to seize the principal problems, by reference to which all others, how important soever they may be, are to be considered as only secondary, we shall in the end perceive, that the measurement of lines, surfaces, and volumes, is invariably the end, sometimes direct, but mostly indirect, of all geometrical labours. This proposition being of capital importance, since it alone gives our definition its full value, it is indispensable that we should enter upon some details; but these must be reserved for another paper.

THE STEAM-ENGINE.

AN OUTLINE SKETCH FOR BEGINNERS.

Water is converted into gaseous vapour, called steam, upon the application of an amount of heat sufficient to raise Fahrenheit's thermometer to 212°, when the atmosphere exerts its ordinary pressure of 15 lbs. on the square inch. At this pressure steam occupies a space about 1,700 times greater than that of the water producing it; in other words, a cubic inch of water, when converted into steam, will expand into nearly a cubic foot. The force exerted in thus expanding, is sufficient to raise 2,130 lbs. one foot high.

Steam possesses the property of elasticity in an eminent degree; that is, it may be compressed into a space much less than that which it would occupy if allowed to exercise unrestrained its power of expansion. Seventeen hundred cubic inches of steam may be compressed, by the application of a certain force, into 850 cubic inches (half its bulk); by the application of a further force, into 425 cubic inches (one fourth of its bulk), and so on—its expansive force increasing in the ratio of the force exerted to compress it. If made to occupy no more space than that of the water from which it is generated, its tension or expansive force will increase in the ratio of 1 to 152. A table, showing the ratios of the density and elasticity of steam, will be found in the *P. M. Journal*, vol. iii. p. 198.

When water is subjected to a greater pressure than the ordinary pressure of the atmosphere, it is necessary to apply a greater degree of heat, in order to convert it into steam. For instance, if 30 lbs. press upon each square inch, instead of 15 lbs., the water must be raised to the temperature of 252° before steam will be generated; and the steam produced will have twice the density—that is, half the bulk of that produced under half the pressure.

Upon these facts is based the employment of steam as a motive power. Before describing the different modes in which steam may be made to act, we will state one or two facts as to its connection with heat. It has been found that 5½ times as much heat as is necessary to raise the temperature of a given quantity of water from 32° to 212° (*i. e.* from the freezing to the boiling point), is required to convert the same quantity of water into steam under every degree of pressure; and, of course, 5½ times as much fuel will be required in the doing of the one thing, as is required for the doing of the other. Of the large quantity of heat thus thrown into the water on its conversion into steam, by much the largest quantity becomes latent—that is, insensible to the thermometer—for the steam raises the mercury to no higher point than that to which it was raised by the boiling water. If the pressure at which it was boiled was 15 lbs. on the square inch, the temperature of the boiling water will be 212°, and that of the steam will be the same. If the pressure should be increased so that the boiling point becomes 300°, the temperature of the steam, as disclosed by the thermometer, will be the same. It is easy to show, however, that the steam really contains a much larger quantity of heat; that it contains, in fact, not only that indicated, but all that which was consumed in its production. For if 1700 cubic inches of steam at 212° (the production of one cubic inch of water), be brought into contact with 5½ cubic inches of water at 32°, the steam will be condensed, and 6½ cubic inches of water will be produced, which will possess the temperature of 212°. It is, therefore, clear, that there was as much heat in the inch of water, which had taken the form of 1,700 inches of steam, over and above the 212° discoverable by the thermometer, as sufficed to raise the temperature of 5½ times the quantity of water from 32° to the same point; that is, there was a quantity of heat equal to 990° of the thermometer, combined with the steam, and not disclosed to the instrument.

Steam, as a motive power, may be made to act in different modes:—

I. *By direct impulsion*—issuing, for example, from a boiler, through a narrow orifice, upon the arms of a revolving wheel. Branca proposed this application of steam in 1629; but it has never been carried into practice, in consequence of its being attended with an enormous loss of power.

II. *By reaction.*—Hero of Syracuse, who lived 120 years before our era, described a little apparatus, in which the steam, on flowing through the lateral orifice of a horizontal tube, moveable round a vertical axis, causes the former to revolve about the latter. No means have yet been discovered for taking economical advantage of this ingenious idea.

III. *By pressure on a liquid.*—In 1698, our countryman, Savary, constructed the machine in the following figure. The steam produced in the boiler, B, pressing on the surface of the water contained in the vessel, S, the cock, C, being open, caused the water to ascend the pipe, A, shutting the valve, *b*, and opening the valve, *a*. The cock, C, being then closed, the steam was condensed in S, by means of a jet of cold water. The atmospheric pressure acting on the surface of the liquid to be raised, would cause the ascent of the water from the lower reservoir into the vessel, S, by the pipe, D, opening in its passage the valve, *b*. The cocks were worked by hand. This machine was attended with several disadvantages. For, first, the difference of level between the lower sheet of water, and that in the vase, S, could not exceed 33 feet, because the pressure of the atmosphere is not more than sufficient to support a column of water of that height. Moreover, the steam of the boiler acting directly upon S, was in great part condensed, and its elasticity was only brought into full action when the water to be elevated was heated. It was found by experiment, that at least 11-12ths of the steam were condensed by Savary's apparatus, by contact with either the water to be acted on, or with the cold sides of the vessel. Therefore, to elevate the water only to a height of 212 feet, Savary was obliged to employ steam with a tension of six atmospheres. These and other disadvantages in the form of his machine induced him to abandon it, and to join Newcomen in the construction of another.

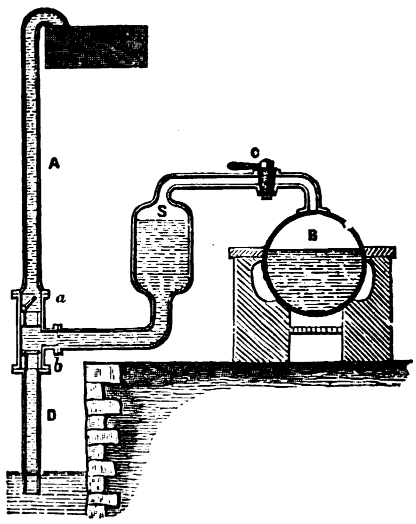


Fig. 1.

IV. *By alternative pressure and condensation combined with atmospheric pressure.*—If the action of the steam is immediately directed upon the under side of a piston, capable of moving in a vertical cylinder, open at the top, but communicating at its lower extremity with a boiler, the steam will drive the piston before it from the lower end of the cylinder upwards. But if we cut off the steam by closing the passage which leads from the boiler to the cylinder, when the piston has been elevated a certain height, and then employ means to cool the steam then in the cylinder, the tension of the steam will decrease, and it will finally be converted into water. The piston being now acted upon solely by the atmosphere pressing from above, will quickly descend from the point to which it had been raised to the bottom of the cylinder, and it will exert a downward force equal to that of its surface, multiplied by the atmospheric pressure. By means of a pulley, an ascending motion, equal to the descent of the piston, may be transmitted to a weight. In like manner, a change in the direction of motion may be effected by attaching the piston-rod to one of the extremities of a beam, capable of vibrating on a horizontal axis at its centre; the other extremity of this beam is loaded a little more heavily than the weight of the piston and its friction. The burdens to be elevated are successively attached to the same extremity of the beam at the moment when the piston begins to ascend. Whatever be the other arrangements, it is evident that the action of this machine is intermittent, and that it is, therefore, only fit to set pumps in motion. During the ascent of the piston, there is no useful development of power; it is only during its descent, under the influences of the pressure of the atmosphere, that its really useful effect is produced. This is the principle of the *atmospheric machines* developed by Papin in 1690.

Newcomen's atmospheric machine, constructed in 1705, was based upon this principle. The steam (see fig. 2) passes out of the boiler into the cylinder, C, through the pipe, S, and destroys the effect of the atmospheric pressure on the upper surface of the piston, P. The weight, W, pulls down the other end of the beam, B, and causes the piston to rise; when the latter has reached the top of the cylinder, the cock admitting the steam from the boiler is closed, and another cock is opened to admit a jet of cold water into the cylinder from the cistern, N, whereby the steam is condensed. The atmospheric pressure then causes the descent of the piston, and raises the weight, W, together with the rods of the pumps fitted to the left arm of the beam. The air, and the uncondensed portion of the steam, issues from the cylinder during the descent of the piston by a lateral valve. The water by which the condensation is effected, escapes by another pipe. The rod, R, works a small pump, which raises the water required to condense the steam in the cylinder into the reservoir, N.

We have already remarked, that machines of this kind were only fitted for working pumps. Their principal inconveniences arose from the cocks admitting steam, and the condensing jet, having to be turned by hand, and from the cooling of the cylinder produced by the means employed to condense the steam. In engines of the present day, the mode by which condensation is effected, is to open a communication between the steam beneath the piston, and an adjoining vessel (the condenser) into which a stream of cold water is played. The steam is thereby rapidly converted into water in this condenser, which ceases to communicate with the cylinder as soon as the piston begins to ascend.

V. *By steam impulsion and condensation always in the same direction.*—Let the piston be inserted in a cylinder hermetically closed both at the top and bottom, and let the piston-rod move with the smallest possible friction through a hole in the lid, without allowing a passage to air or steam; in this case the atmosphere will be prevented from pressing upon the piston, or causing it to descend. But the mechanism may be so contrived as to permit the steam to have access to the upper surface of the piston, whilst there is a communication between the lower part of the cylinder and the condenser. The ascent of the piston is effected as in the atmospheric machines, by means of a counterpoise at the other end of the beam, the pressure of steam on the upper surface of the piston being cut off. A machine of this kind, when the piston is moved by steam alone—the two modes of action always taking place in the same direction—is no more fitted than an atmospheric machine to produce a continuous motion. But the up and down motion of the beam may be converted into a continuous circular motion, either by employing the water elevated by the pumps to turn a bucket-wheel, or by adapting a crank to the end of the beam.

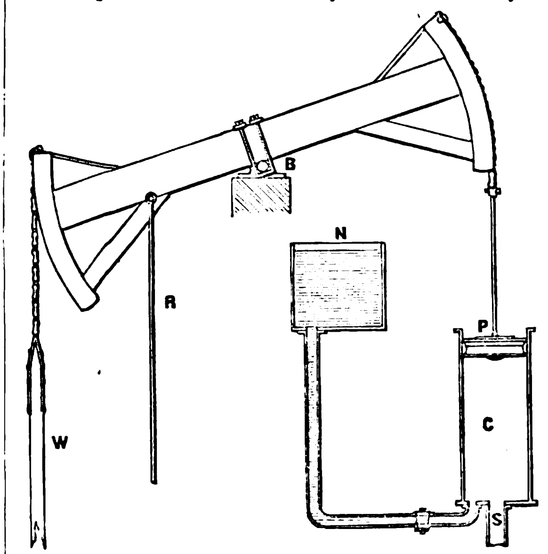


Fig. 2.

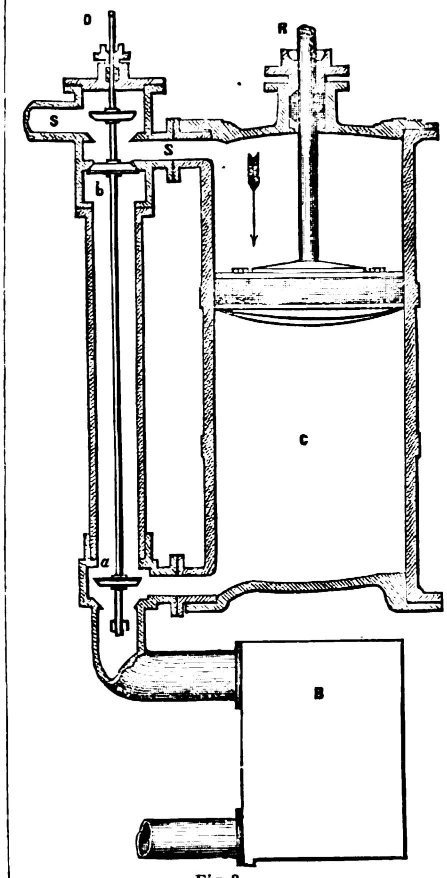


Fig. 3.

The general construction of Watt's early engines was similar to what we have described. The annexed figure (fig. 3), is a section of such an engine. By supposing the rods, R and D to be fixed to one arm of a beam, to the other of which are fixed the rods of draining pumps and the counterpoise, the reader will easily complete the figure for himself. The steam passing along the pipes, S S, begins to press the piston on its upper side, whilst a communication is opened between the bottom of the cylinder and the condenser, B. When the piston has reached the bottom of the cylinder, the rod, D, descends, and the passage of steam from the cylinder to the condenser is intercepted by the small valve, *a*. The valve, *b*, is at the same time lowered, and a communication is thereby opened between the upper and lower divisions of the cylinder. The piston being now equally pressed on each side, ascends by reason of the counterpoise at the other end of the beam. All that has to be done, therefore, is to regulate the motion of the rod, D. This can easily be done by attaching it to the beam in such a manner that it shall rise when that arm of the beam goes down, and that it shall descend when the arm goes up. This machine is also attended with the disadvantage of not acting continuously, and being suitable only for pumping.

Watt's first patent was dated in 1769. His glorious career was begun with, perhaps, the most important of his discoveries, that of the separate condenser.

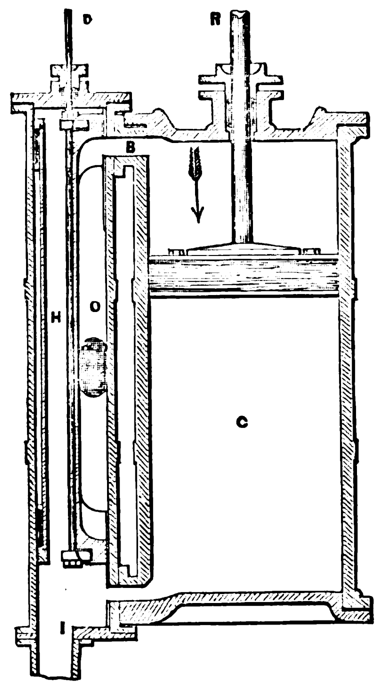


Fig. 4.

VI. *By simultaneous steam pressure and condensation alternately in opposite directions.*—Instead of condensing the steam only underneath the piston, condensation may be alternately effected above and below, the steam being made to press upon that side of the piston which is not in communication with the condenser. This forms a *double-acting* engine.

Fig. 4 shows the construction of the cylinder in an engine of this description, such as Watt made in 1782. The rod, D, instead of carrying three small pistons, corresponding to so many orifices, has one large slide. In the position indicated, the slide permits the steam, on issuing from the boiler by the orifice, *o*, to act on the upper side of the piston, through the passage, B, whilst the passage, I, from the lower part of the cylinder to the condenser, is left open. When the piston, in its descending course, has reached the bottom of the cylinder, the slide being carried downwards by the rod, D, descending simultaneously with the piston, closes the passage, I, to the condenser, and opens a passage for the steam issuing from the orifice, *o*, to act upon the lower surface of the piston upwards. At the same time the passage, B, is stopped, so that the steam ceases to issue upon the upper side of the piston, and a communication is opened through the passage, H, between the upper part of the cylinder and the condenser.

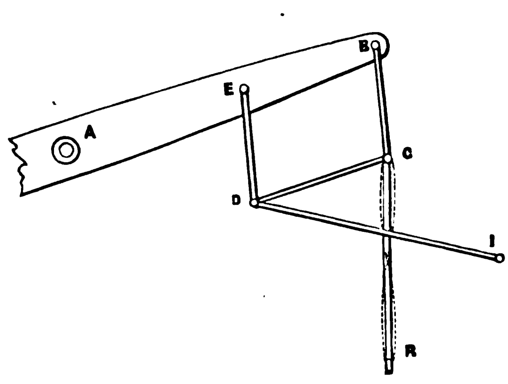


Fig. 5.

The ingenious mechanism of the slide would not, however, avail to give an alternate up and down motion to the beam, unless the rod of the

piston were fixed to it in an invariable manner. But since the piston-rod must necessarily work in the same vertical line, in order that the piston itself should form a steam-tight barrier in moving up and down the cylinder, it is evident that the top of the piston-rod cannot be directly affixed to the beam, inasmuch as every point of the latter, in its upward and downward motions, describes a portion of a circle. Watt surmounted this difficulty by a contrivance of singular elegance, which is called a parallel motion. The preceding figure (fig. 5) will explain it. A B, Is a beam moving round the fixed axis, A; I, is another fixed point. The inflexible rods, B C, C D, D E, D I, are all moveable round the joints, B, C, D, E, I. When the beam receives an alternate motion of rotation around its axis, A, the parallelogram, B, C, D, E, takes different forms, and the point, C, tends to describe the dotted curve indicated in the figure. This curve deviates from the vertical, C B, to such a trifling extent, within the limits of the play of the beam, that the rod, C B, may be taken to move upwards and downwards in a vertical line.

VII. *On the expansive principle.*—If the steam were allowed to issue from the boiler upon the piston during the whole time of its descending or ascending course, it would advance with a continually accelerated motion to the very end of the cylinder, which would receive from it a violent blow. The practice has consequently arisen of closing the communication between the boiler and the cylinder before the piston has completed its course. The piston, however, continues to move onward by virtue of the velocity already acquired, and of the elastic force of the steam which has made its way into the cylinder. The velocity gradually diminishes, and has ceased by the time the piston has reached the extremity of the cylinder. This contrivance was at first used only with the view of preventing the violent concussion of the piston upon the extremities of the cylinder, but it is now generally employed, having been found of use for other purposes. If, instead of keeping the steam at its maximum of tension in the cylinder during the course of the descent of the piston, it is cut off when the piston has traversed a half, a third, or a fourth of its course, that steam which has entered the cylinder will continue to act upon the piston by reason of its property of expansion. In this case the quantity of steam which it is necessary to condense at each stroke of the piston is very much less than it would otherwise be, and yet all the required effect has been produced.

It is so important to understand this mode of working a steam-engine, that we shall transcribe the words of a writer in the *Penny Cyclopædia* upon the subject:—"When the steam is first admitted into the cylinder, the total space filled by the steam is immediately augmented by that through which the piston moves, and if the capacity of the boiler were not several times greater than that of the cylinder, the consequence would be a gradual diminution of the pressure, supposing the total quantity to remain the same; but the moment the pressure in the boiler tends to diminish, an additional quantity of water passes into the state of vapour, of the same tension as that previously generated, provided the temperature be maintained; hence the pressure on the piston may be regarded as sensibly the same throughout the whole of its stroke, provided that pressure be somewhat greater than that of the atmosphere, and the communication with the boiler remains open. But if the pressure be considerably greater than that of the atmosphere, the steam, even when separated from the water while expanding in the enlarging space formed by the motion of the piston, will exert sufficient force to continue that motion, till at last the pressure diminishing inversely as the space increases, and directly as the temperature, that pressure will finally not be in equilibrium with the resistance, and all motion will cease. In the common engine, if the pressure on the piston continue uniform during the stroke, as it would do if the communication with the boiler remained open, the piston would move with an accelerating velocity till it arrived at the end of the cylinder, when the motion in that direction being suddenly stopped, the momentum must be expended on some of the fixed points of the machine to its manifest injury, and with the useless expenditure of so much power; accordingly, the communication with the boiler is always cut off when the piston has arrived at a certain point, and with a momentum sufficient to carry it to the end of its stroke without any useless expenditure of force, while the steam behind it, which was originally of but a few pounds pressure above that of the atmosphere, thus limited in quantity, rapidly declines in force, and ceases to urge the piston on. But on the expansion principle, when the steam possesses considerable elastic force, the communication with the boiler may be cut off much sooner, and the piston is urged forward by the expansive force of the steam, which, although decreasing as the space increases, is yet sufficient to carry the piston to the end of the stroke."

It is easy to conceive that the slide may be so attached to the beam, that the steam shall be allowed to issue from the boiler during a part only of the downward course of the piston. At page 28 of our third volume will be found a detailed description of expansion machinery. When the engine is constructed with two cylinders, the slide may be so arranged that whilst the steam acts upon the small piston, that vapour which is underneath expands and presses upon the other piston in the same direction.

VIII. *By high alternate pressure without condensation.*—In all the engines hitherto referred to, it is not necessary that the steam should act with a pressure greater than that of the atmosphere. In atmospheric engines, the counterpoise admits a tension even much less. But in many cases a very powerful force is required to act within a small space, and with the least possible weight of machinery; and it becomes desirable to dispense with the condenser and its burdensome apparatus. This is particularly the case in locomotives. Instead, therefore, of condensing the steam when it has acted upon the piston, it is driven off into the air; but in order to effect this, it is requisite that the vapour pressing upon the other side of the piston should be of higher tension than that of the atmosphere. The loss of force arising from non-condensation will be less in proportion to the greatness of that tension. Thus, at a pressure of ten atmospheres, a non-conducting machine would only lose one-tenth of the force produced; but if the pressure were three atmospheres, the loss would be one-third. This is the principle of high-pressure non-condensing engines, and in these the expansive mode of working becomes important. In fixed engines, the principles of high pressure and expansion are combined with the condensing apparatus. A second cylinder is occasionally employed, of a larger diameter than the first, having a piston which is impelled in the same direction, and at the same moment as the other. An example of this construction is given in Plate 52 in our third volume.

Steam-engines are made to supply themselves with water and fuel, and to regulate the intensity of the fire and the pressure of steam.

In low-pressure engines, the contrivance for supplying the boiler with water consists of a hollow metal, or stone *float*, lying on the surface of the water. To this is attached a rod, which passes through the top of the boiler, and acts upon the valve of a cistern, so that, when the rod falls, the valve is opened, and water flows into the boiler along a tube placed under the valve, when the rod rises, the valve is closed, and the supply of water is cut off. The lower end of the tube descends below the level of the water in the boiler, and the pressure of the steam supports in it a column of water. This is the *self-acting feeder*.

In high-pressure engines, a forcing pump, called a *feed-pump*, worked by the engine, is needed to throw water into the boiler, because the column of water required to overcome the tension of the steam would be too high.

The regular action of the piston is rendered uniform by means of a fly-wheel, the diameter of which should be three or four times larger than the stroke of the piston. This contrivance consists of a large wheel of metal, with a very heavy rim. When the action of the piston is conveyed to its great mass, a great amount of force is absorbed by it; and it acquires so large a momentum, that the irregularity of the piston's motion is rendered nugatory. The fly-wheel is of great use in all cases where the resistance or moving force is liable to rapid changes, because the velocity of its rotation will not vary in the same manner; but, by virtue of the law of inertia, the wheel will keep up a nearly uniform rate of motion. This contrivance may be compared to a reservoir, into which is collected the moving force when it exceeds the resistance to be overcome, and which gives it out again when the resistance becomes greater than the force. The valuable result of employing a fly-wheel to condense force, has led some persons to suppose that this contrivance increases the actual power of a machine. This is not the case; on the contrary, since the weight of the wheel induces a large amount of friction on its axle; and since it meets with resistance from the atmosphere in proportion to its size and velocity, there is, in reality, a loss of force by its use. But this loss is trifling in comparison with its advantages. It is never employed except in those cases in which the force, or the resistance, or both, are liable to variation; and it is placed as near as possible to that part of the machinery, the motion of which is variable.

Another contrivance for rendering the action of a steam-engine uniform, is that known as the governor, another of the ingenious inventions of Watt. Let us take two inflexible metal rods of equal length, loaded at their lower ends with balls of the same weight, and attached at their upper extremities by joints to a vertical spindle, so as to revolve along with it. Variations of velocity in the revolutions of the spindle which is kept in motion by the engine, will manifest themselves by corresponding variations in the angular distance of the rods from the spindle, such distance being dependent upon the amount of the centrifugal force. In other words, the balls will fly apart when the revolutions of the spindle increase, and will approach each other when they diminish. Now these variations of angular distance can be conveyed by means of other jointed rods acting as levers to a valve, called the *throttle valve*, placed

in the passage, by which steam is conducted from the boiler to the cylinder. When increased pressure of steam on the piston has caused the spindle to revolve with greater rapidity, the machinery alluded to partially closes the throttle-valve until the pressure is reduced; and when the pressure is below what it ought to be, the same machinery opens the valve so as to admit a larger quantity of vapour into the cylinder.

By contrivances of the same nature, the heat conveyed to the boiler may be regulated either by means of a slide—called a damper—acting on the draught of the chimney, or by increasing or diminishing the supply of fuel.

In some boilers the fire is placed beneath, in others it is placed in a large tube inside. The air, which is heated by the fire, is not allowed to escape into the atmosphere at once, but is made to traverse passages called *flues;* which are sometimes placed outside, sometimes constructed in the shape of narrow tubes that pass through the boiler; the intention, in all cases, being to make the air give up its heat to the water. Boilers are usually either cylindrical or waggon-shaped. They should have a volume from 36 to 45 times larger than the cylinder. During the working of the engine, the water occupies about two-thirds of the interior, and steam the remaining space. Explosions arising from the elasticity of steam within is guarded against by the use of *safety-valves*, which, when the pressure exceeds a certain amount, open and allow the steam to escape into the atmosphere, closing again when the pressure is reduced below that amount. Another safety-valve, acting in the other direction, admits air into the boiler whenever a vacuum is produced by the condensation of steam within; as, for instance, when the fire is extinguished. For an illustration of the mode in which both these safety-valves may be combined, see vol. ii. page 204.

It is, of course, necessary to the due working of the engine, that the piston shall move freely in the cylinder in such a manner that no steam shall pass between them; that is, the piston must be steam-tight. It was formerly usual to make pistons of a quantity of hemp tightly compressed between two plates of metal; but of late years they have been made altogether of metal, and a great deal of ingenuity has been expended upon their construction. Examples may be seen by referring to pages 129 and 246 of our second volume.

The papers which have recently appeared in our *Journal* as to calculating the useful effect of steam-engines, may be consulted by those who desire to see the most approved formulæ relating to this intricate subject.

PATENT LAW AMENDMENT BILL.

No. III.

Inventors and patentees have been taken by surprise by the introduction into the House of Lords of this bill, purporting to be drawn upon the ground-work of the two bills brought forward in the early part of the session—No. 1, by Lord Brougham, and No. 2, by Lord Granville.

It has been passed through the Lords, and now awaits the decision of the House of Commons upon it.

Most of our readers are aware that a committee of the House of Lords was for some time occupied in examining witnesses upon the present state of our patent laws, and we are to take the present measure as based upon their report to the house.

The most singular feature of this bill is, that it appears to pave the way for a general abolition of all protection to inventors by letters patent. Lord Granville, on introducing the bill, gives his own views strongly in favour of such an abolition, whilst, at the same time, he admits that public opinion runs most strongly in favour of a judicious system of patent laws. Lord Granville quotes, in favour of his own ideas, the evidence of Mr. Cubitt, Mr. Brunel, Mr. Ricardo, M.P., Colonel Reid, Mr. Farrie, and Sir John Romilly; and although we did not think five men, whose names are so well known to the public, would have given their sanction to a project so palpably absurd—yet they are by no means the men whose opinions are entitled to most weight in such a matter.

In introducing the bill, Lord Granville mentioned to the house that the committee had been much indebted to the services of Mr. Webster, "who attended their meetings constantly, and aided them by his valuable suggestions," the result being that some of the worst provisions of the bill bear a strong resemblance to those contained in the pamphlet published some months ago by that gentleman. This again reminds us that Mr. Webster is at present the person appointed by the Attorney-General under the *Designs Act Extension Act* of this session, to give the necessary certificate for the provisional registration of patentable inventions exhibited in the 1851 Exhibition; and, probably, may have an eye to one of the commissionerships proposed to be created by the present bill, as he seems to be in considerable favour with her majesty's legal advisers in the present ministry.

We will now proceed to give our readers a short epitome of the proposed measure.

In the first place, it is proposed to constitute a commission, to consist of the Lord-Chancellor, the Master of the Rolls, the Attorney and Solicitor-Generals of England and Ireland, and the Lord-Advocate and Solicitor-General of Scotland, with such others as may afterwards be appointed, such commissioners to appoint such officers as they may deem expedient, and to make rules in accordance with the provisions of the act, and to make an annual report to parliament. The petition and declaration for the grant of letters patent, with an outline specification, are to be left at the Great Seal Patent Office, and to be referred, as at present, to one of the law officers—one of the persons to be appointed by the commissioners to report upon the sufficiency of the outline description, and such report being filed at the Great Seal Patent Office, the invention is provisionally protected for six months, which may be extended for a further period of three calendar months.

The petitioner may, if he thinks fit, leave with his application a full specification of his invention; but it does not appear to us that he is to reap any peculiar advantage by so doing. The invention, provisionally protected as above, may be used without danger to the validity of the patent, which may be sealed as of the date of the original application; but without the patent is sealed within the term of the provisional protection, the grant will be void.

When the applicant desires to seal his patent, he is to give notice to the commissioners to that effect. The commissioners then publicly advertise the application, and all parties are at liberty to oppose it, by sending to the commissioners notice, in writing, of the grounds of their objections. When the time for the delivery of such objections is expired, the provisional specification and the objections are to be referred to an examiner for his report to the law officer thereon.

The power of appeal against this report is given to the law officer, to whom the application was referred.

After the receipt of the final report, the law officer is empowered to issue his warrant for sealing letters patent for the *United Kingdom of Great Britain and Ireland, the Channel Islands, and the Isle of Man*, this warrant to answer all the purposes of the present Queen's Warrant, Patent Bill, Queen's Bill, Signet Bill, and Privy Seal Bill; but no patent is to issue upon this warrant except within three months from its date. The patents are to contain a proviso annulling them at the expiration of three and seven years respectively, unless the further sums in respect of fees and stamp duties set forth in the schedule shall be then paid.

After the clerk of the patents has received the warrant, as above, he is to issue three transcripts of the letters patent, to be passed under the great seal, the seal appointed to be used in place of the great seal of Scotland and the great seal of Ireland.

A very important clause is then introduced, providing that the use or publication of an invention abroad, prior to the date of the letters patent in this country, shall vitiate the grant.

Copies of all specifications, disclaimers, memoranda of alterations, and provisional specifications (after the term of provisional protection has expired), are to be open for inspection at the commissioners' offices in London, and at offices in Edinburgh and Dublin.

The commissioners are to cause indices of all specifications, disclaimers and memoranda of alterations to be prepared, and also to print such specifications, and publish and sell them when and as they may think fit; but all specifications enrolled under the provisions of the bill, are to be printed immediately after they are filed, and the patentee is to have twenty-five copies, without any charge. The Lord Chancellor, and the Master of the Rolls, may direct all specifications, and other papers, to be kept in any place they may appoint for that purpose.

A register of *all* patents, specifications, and papers, is to be made in chronological order, and kept at the Great Seal Patent Office, for inspection by the public.

There is also to be kept a "register of proprietors," wherein is to be entered an account of all transfers, assignments, licences, and other transactions of a like nature.

The period "of provisional protection" may be extended upon payment of £10.

The fees and stamp duties mentioned in the schedule, and given below, are to be paid, and to constitute what is to be called a "patent fee fund," out of which the salaries of the several officers are to be paid.

The usual clause for providing compensation to officials at present occupied in the passing of patents, is directed to be paid.

FEES TO BE PAID UNDER THE PROPOSED ACT.

On leaving petition for grants of letters patent,	£5	0	0
On notice of intention to proceed with the application,	5	0	0
On sealing of letters patent,	5	0	0
On filing specification,	5	0	0
At, or before the expiration of the third year,	40	0	0
At, or before the expiration of the seventh year,	80	0	0
On extension of period of provisional protection,	10	0	0
On leaving objections to granting of letters patent,	2	0	0
Every search and inspection,	0	1	0
Entry of assignment or license,	0	5	0
Certificate of assignment or license,	0	5	0
Filing application for disclaimer,	5	0	0
Caveat against disclaimer,	2	0	0

STAMP DUTIES.

On warrant of law officer for letters patent,	5	0	0
On certificate of clerk of patents of payment of fee at expiration of third year,	10	0	0
Ditto, ditto, seventh year,	20	0	0

The two most objectionable parts of this bill, appear to us to be the total exclusion of the colonies, and the clause providing that the publication or use of an invention in any foreign country, is to be a bar to a valid patent for the united kingdom.

No reason whatever has been assigned for these absurd provisions, and, until we are favoured with the evidence given before the committee, it is impossible to guess at the grounds for their introduction.

We cannot, however, conceive that the House of Commons, containing, as it does, many men practically engaged in manufacture, and who have personally felt the advantage of patents, although upon the present costly and cumbrous system, will pass a bill containing such clauses as these.

There is also a great omission in the fact that no power is given to allow separate patents to be granted for Scotland or Ireland at reduced fees. We know, from our own experience, that inventors very frequently desire protection in one division of the empire only, and there is no reason why it should not be extended to them on payment of a reduced scale of fees.

The bill shows what the present government is no doubt very desirous of having, a new "commission," in which some of their retainers may easily receive a reward for other services; probably enough some of the gentlemen who will receive compensation for the abolition of their offices will be again put into office under this bill, making a repetition of what has so much disgusted the public in chancery reform, where numerous sinecure offices have been abolished, the gentlemen who held them receiving an enormous sum as compensation, and being reinstated in offices in other departments, with equivalent salaries, thus pocketing, at the same time, the compensation and new salaries.

There are many salient points in the bill that we have not alluded to; but we will not try the patience of our readers further at present, taking leave of the subject with a fervent hope that, if this is to be the sole "Patent Law Reform" to be offered to inventors, such a measure will never receive the sanction of the representatives of the people.

BLACKWOOD'S BEAM WATER REGISTER.

Fig. 1.

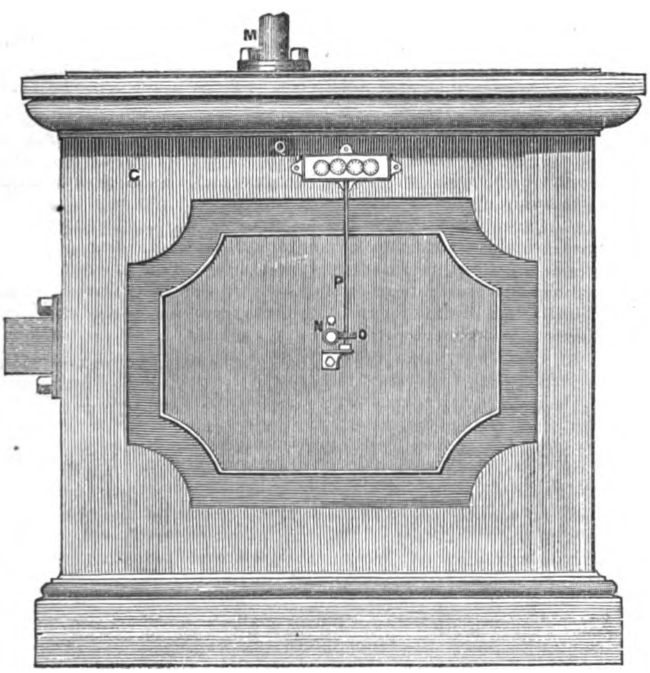
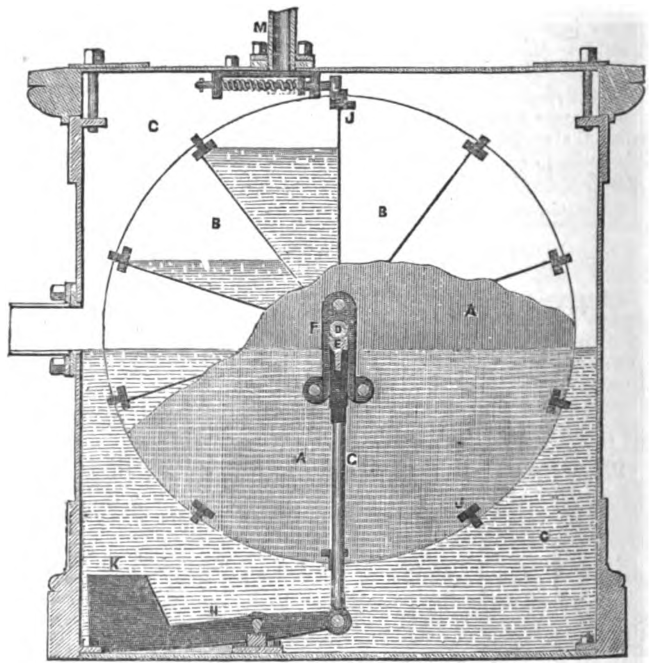


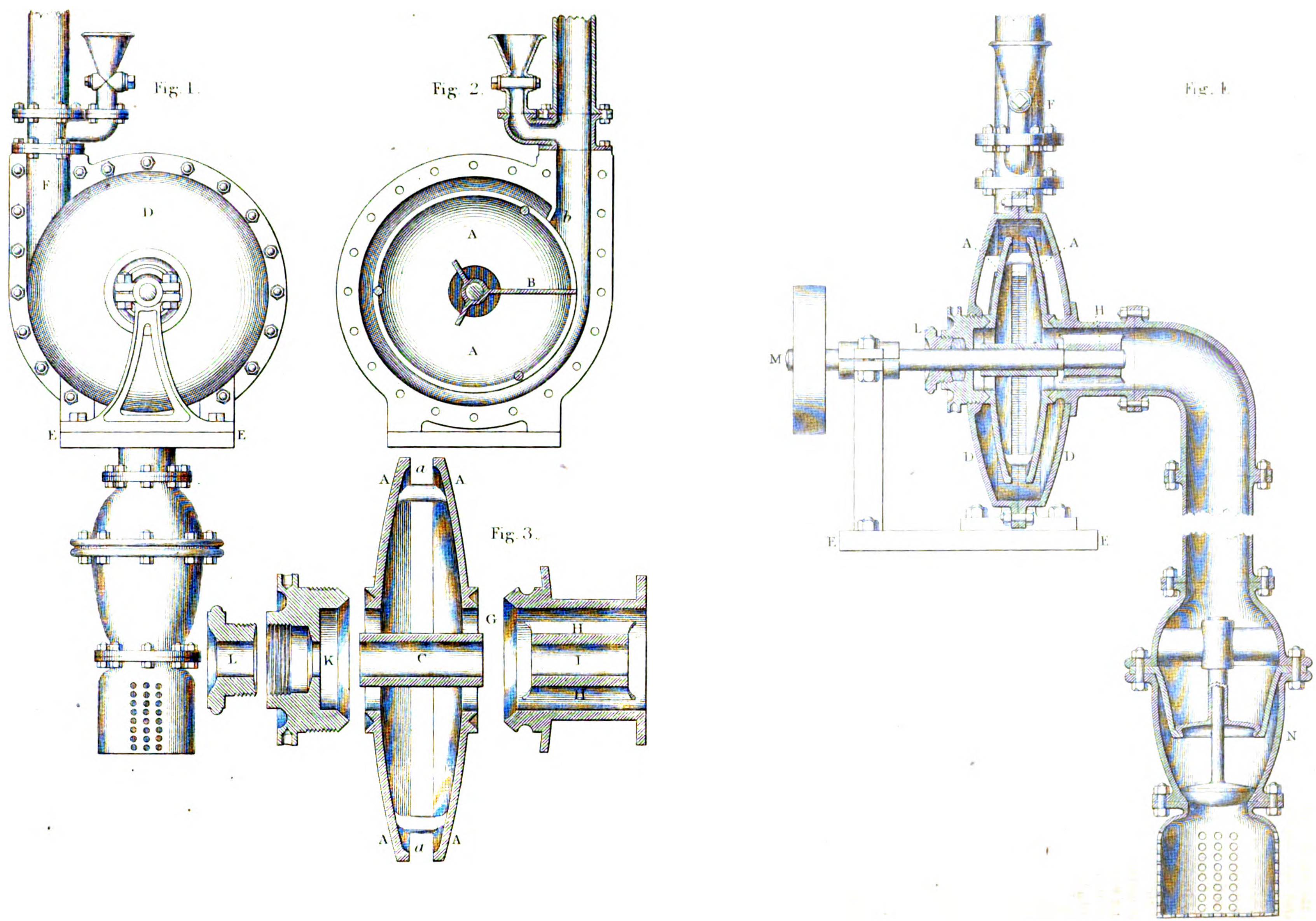
Fig. 2.



1-12th.

This water-register or meter is the invention of Mr. R. Blackwood, jun., C. E., of Kilmarnock; and has now been for some time at work at the Kilmarnock station of the Glasgow and South-Western Railway. Fig. 1, of our engravings, is a front external elevation of the apparatus; and fig. 2 is a vertical section through the case and wheel, part of the latter being removed to exhibit the internal details. The principal feature of the meter, is the measuring-wheel, A, made of light copper, and divided into ten compartments or open-mouthed buckets, B, in which the water is measured. This wheel is enclosed in the iron chest, C, revolving in brass bearings on its inner sides. One end of the wheel's axle revolves in a hollow bearing fastened to the inside of the chest, and the other end, D, works in a moveable bearing, E, which rises and falls in the brass guide, F, the bearing being attached to, and carried by the rod, G. The latter is jointed at its lower end to one end of the lever or beam, H, having at its opposite end a counterweight, K, nicely adjusted to the weight of the water in the bucket. Along the periphery of the wheel, and opposite each division, are fixed brass snugs, J, which are arranged to rest in turn against the stop, L, carried by the lid of the chest. The water to be measured, enters by the pipe, M, at the top, and the measured water flows off by the pipe at the side. On admitting water by the pipe, M, the most elevated bucket becomes filled, when the weight of the accumulated water overcomes the counterweight, K, on the beam, H, below, causing the wheel to descend slightly in a vertical direction. This movement relieves the snug, J, in action at the time, from the stop, L, and the weight of the water in the full and partially full buckets on the forward side, then causes the wheel to revolve. This partial revolution empties the lowest of the discharging buckets, thus lightening the wheel, which now rises to

GWYNNE'S CENTRIFUGAL PUMP.



its first level, and the next snug in rotation comes against the stop, L, holding the wheel until the succeeding bucket is filled, when the action is repeated, the counterweight, K, always bringing up the wheel into its position at the discharge of each bucket. The wheel has thus a constant succession of descending, revolving, and ascending movements; and as it revolves a given distance and no more, at each discharge, this rotatory action is taken advantage of in counting and registering the quantity of water passed through. The wheel is immersed in water nearly to its centre, and the stop, L, is fitted with a helical spring to deaden the shocks as it turns. An endless screw, N, fixed to the shaft, and brought out through the side of the chest, works into a toothed wheel, O, on the vertical shaft, P, and thus communicates motion to the train of indicating wheels in the dial-plate, Q, which is arranged to indicate from 1,000 to 10,000,000 gallons.

Mr. Blackwood's invention appears to be well adapted for manufacturing establishments, railway stations, or breweries, where large quantities of water are required, as it may be made any size, whilst no water can pass without giving its accurate indications of transmission—the water being, in fact, actually weighed out. A great point in a meter of this construction is the total absence of all valves, floats, or stuffing-boxes, as well as of all objectionable rubbing surfaces, so that muddy water or the presence of any foreign matter, cannot affect the accuracy of the indications. The meter from which our drawings were made is 30 inches in breadth by 16 inches in width, and stands 3 feet high. It is capable of passing 50,000 gallons in 24 hours. Its simplicity and trifling first cost are obvious.

GWYNNE'S DIRECT-ACTING BALANCED CENTRIFUGAL PUMP.

Illustrated by Plate 76.

One of the greatest of the practical curiosities of the "machinery in motion" in the Great Exhibition, is the simple rotatory pump recently patented by Mr. Gwynne, the patentee of the balanced water-wheel, illustrated and described in our June part. The mechanism of the pump consists simply of a couple of concave metal discs, revolving together upon one horizontal shaft, and so placed with respect to each other as to leave a ring aperture all round between their neighbouring peripheries. This constitutes the whole of the moving apparatus—the machine being completed by a fixed external water-case, driving-pulley, and lift and discharge pipes for the fluid.

In attempting to construct a centrifugal pump, a very large number of inventors have exhausted their skill in making arrangements of spiral or curved arms on an axle, or in endeavours to find the supposed angle or curve, with the diameter which the fluid would make in passing off, being in utter ignorance of the fact that in obedience to the law of central forces, the escaping fluid takes the shortest line to reach the circumference; or in other words, that each particle of matter in a state of rotation, when free to escape, moves directly in the line of the radius until it reaches the circumference, and thence follows the tangent line until influenced by gravity or some other disturbing force.

This fact is very beautifully demonstrated by placing balls of white-lead in the suction-pipe, when it is seen that as they pass between the plates composing the piston-wheel of the pump, they mark their several lines of direction on the plates with great distinctness—some of them being thick and heavy, and others as fine as the fibre of the silkworm. The natural law to be observed in the arrangement of a centrifugal pump was thus settled.

Unlike the cumbrous inventions of antiquity, the balanced centrifugal pump is quick in action, small in size, compact in structure, capable of being placed in any situation, and of being applied to every description of work. Differing from the household pump, its power may be indefinitely increased, its volume of water made ample, and its flow continuous. Superior to the forcing pump, it has scarcely any appreciable friction, is not restricted in action by the intervention of an air-chamber; and contrasted with what must be regarded as merely engineering curiosities, some recent examples of which are constructed under an imperfect apprehension of the laws of centrifugal force, it has no parts which can get out of order, no useless reduplications of apparatus, and none which can in any degree impede the flow of water.

The balanced centrifugal pump has a rotatory action, by which a centrifugal movement is given to the inclosed water, which it discharges in radial lines coincident with the direction of the centrifugal force, into a flattened spheroidal chamber, constituting the body of the pump; and this chamber has but one exit-pipe, placed at a tangent with its circumference. The water, as it is thrown off from the open periphery of the revolving piston, is forced up the discharge-pipe in quantities, and at a rate proportioned to the speed at which the piston is driven, but which, it is ascertained, will not be less, under favourable circumstances, than 90 per cent. of the driving power, a result greatly exceeding the performance of any other pump. The details of construction will be readily understood from the following technical description of plate 76:—Fig. 1 is a side elevation of the pump complete. Fig. 2 is a corresponding vertical section, or elevation with one side of the external case removed, and delineated as looking upon the side opposite to that shown in fig. 1. Fig. 3 is an enlarged transverse section of the pair of revolving discs, with corresponding longitudinal sections of the details of the bearings; and fig. 4 is a vertical transverse section through the discs, fixed case, and lift-pipe, with the driving-pulley and supporting-frame *in situ*.

The piston is formed of two concave discs, A A, placed parallel, with their concave surfaces towards each other. Two saucers placed in corresponding positions would give a popular idea of the arrangement. Between these discs is a single arm or impeller, B, radiating from a boss or hollow axis, C, mounted on a shaft which works horizontally, vertically, or at any intermediate angle. The impeller, which regulates the distance between the discs of the piston, varies in breadth. Its narrowest part is at the outer edge, *a*, of the piston, and it becomes gradually broader until its edge intersects the inner surface of the opening in the suction side of the piston, from which line to its extremity at the boss, its edges continue parallel to each other, and at right angles to the axis of the shaft. Its breadth is varied in such a ratio that the areas of any section cut from the piston by the surfaces of circular cylinders, whose axes coincide with that of the shaft, shall be equal to such other section at any distance from the centre; and these areas are made equal, in order that the column of water, or other fluid, entering the piston when in a state of revolution, may have an uninterrupted flow from the centre to the circumference, and that the quantity received and discharged may be constantly equal. This is considered to be essential when large bodies of water are to be discharged, or when high velocities are required. The discs, or inner surfaces of the piston, do not, as will be perceived on reference to the sectional figures, meet at their outer edges, but leave an annular opening, *a a*, around the whole circumference, whose area is equal to the area of the opening at which the water is admitted into the piston.

In working the pump, the water is poured into the piston, at its centre, through a circular opening in one of its sides, and concentric with it. The area of the central opening, and of course of all the others, depends upon the object to be obtained, and the determination of them is regulated upon the principle above mentioned, and by considerations of the quantity of water to be discharged. The piston is enclosed in a case, D, of circular form, placed parallel, and concentrically, with the discs, and this case, which acts as a receiver, is bolted to any convenient stand or frame, E E. From the circumference of the case or receiver rises, at a tangent with it, the perpendicular discharge-pipe, F. The area of this receiver should exceed both those of the discharge-pipe and of the annular opening on the circumference of the piston, in order that an uninterrupted flow of the water may be maintained; and to prevent the water from rotating in the case, and to give it a direction upwards to the discharge-pipe, a stop, or plate, *b*, is placed on one side the base of the discharge-pipe, reaching from thence to the edge of the piston, and sometimes extending on both sides of the piston to the joint between the piston and the outer case, and generally in the line of direction of the radius of the piston. A space is also left between the sides of the piston and of the case, at least equal in size to that of the annular opening in the sides of the piston.

Round the opening in the sides of the piston is a collar or projection, G, outwards half-way to the case. In the case is a circular hole somewhat larger than the one in the piston, and through this hole is passed the suction-pipe, which pipe is riveted or bolted to the outer case. The suction-pipe and half the case are sometimes cast in one piece, but it is generally preferable to make them separate. The inner end of this pipe has cast on it a collar or projection corresponding in shape and concentric with the collar on the piston, and on its outer end is a flange or screw, to which any ordinary suction-pipe may be attached. The joint between the suction-pipe and piston being carefully made and so situated that no sand, gravel, or other gritty matter can lodge on or near it, the wear is so reduced as to become imperceptible. This joint, it must be observed, is an important feature in Mr. Gwynne's invention. The suction-pipe may be curved at its outer end if desired, and its diameter internally may be made larger than the opening into the piston, so as to compensate for the bearings, H H, cast in it, and which carry the inner journal of the shaft, I. These bearings are made three or more times the length of its diameter, and it is found that the water lubricates it effectually, so that very little wear takes place. Mr. Gwynne has recently examined one which had been running day and night for six

months, and no perceptible wear had occurred. The joints between the pipe and piston may be made round, or at any desired angle. The bearings in the suction-pipe form a small hollow cylinder inside the pipe, and on the same axis with it, and it is supported by two or more arms extending from its exterior surfaces to the interior surface of the suction-pipe. If two, these arms are the opposite extremities of a diameter parallel to the axis of the pipe. The whole of the suction-pipe with the bearing cylinder and its supports, are cast in one piece.

In the side of the piston opposite to that in which the suction-pipe is inserted, an opening is formed circular and concentric with it, and nearly equal in diameter. On the side this is surrounded with a collar, K, projecting outwards, similar in all respects to that on the opening connecting with the suction-pipe. An opening is also left in the outer case on the side opposite the suction-pipe, circular and concentric with that and the piston, in the same side and of a diameter equal to that of the exterior surface of the collar which surrounds that opening. In this aperture is inserted a very short straight cylindrical pipe, or rather hollow balancing-nut, L, formed substantially as represented in the plate; but this arrangement admits of much variation. The interior diameter of the balancing-nut is equal to the interior of the diameter of the openings in the piston, on the side opposite the suction-pipe, and whose axes coincide with that of the shaft. The end of this pipe or nut is made of the same thickness as the collar on that side of the piston, and it is adjusted to the work of the pump by means of an external screw cut on it, and an internal screw cut in the outer case, (or by any other means substantially the same,) so that it can be made to bear equally, and with whatever amount of pressure may be desired, on the piston. The moveable joint between the nut and piston is made similarly to the one between the suction-pipe and piston, as already described. The object of this pipe or nut is to equalize the lateral pressure on the piston, which would give rise to very serious inconveniences in the use of the pump, when great elevations of water were to be obtained; for, in raising it to great heights, the pressure would be excessive, amounting to many tons.

Through the outer end of this pipe or balancing-nut, the shaft, M, passes, embraced by a stuffing-box and gland, which prevents the water from escaping, and carrying the piston at one end. Outside, and clear of the stuffing-box, is the main journal of the shaft, and beyond this is a pulley for driving the pump.

In some situations, and for some uses, two suction-pipes have been attached; and when arranged in this manner, no balancing arrangement is required, as all lateral pressure is removed, or rather the pressure is made to act equally on both sides of the piston. Again, it has been found convenient to place two pistons on one shaft, with a separate case to each, the pistons taking the water from one common suction-pipe, or each one a separate suction, but on sides opposite to each other. In either of the latter instances, the balancing arrangement is not required, for the lateral pressure on one piston is counterbalanced by that of the other, transmitted through the shaft, either by tensile or crushing force, as the case may be.

To give stability to the piston in connection with the shaft, two short arms are cast with it, at equal distances from the impeller, each one in a plane with the axis of the shaft, and extending on the boss to a distance equal to that between the interior surfaces of the piston at the opening in the side at which the suction-pipe and balancing-nut are placed. These arms extend from the boss into the piston as far as the exterior diameter of the collar which surrounds the opening in the suction side of the piston. The whole of the piston and of these arms are cast in one piece, by means of proper cores, and it is fastened to the shaft by the aid of keys, feathers, or set screws. The boss, impeller and arms, can be cast in one piece, and the circular surfaces riveted to them. Much labour is saved, and a better result secured by casting them in one piece. In some situations, and for some purposes, Mr. Gwynne prefers casting the piston with one or more holes, generally four, radiating from the centre, and of various forms, round, square, elliptical, or rectangular, but always graduated as to their areas on the principles which he has laid down in his treatise on the pump.

As a fire-pump, one of the smaller sizes will throw out 4,000 gallons per minute, with a nine-inch pipe. As a mining-pump, the following tabulated statement will illustrate its performance:—

Diameter of Piston.	Number of revolutions to raise water 7½ feet.	30 feet.	120 feet.
6 inches	800	1600	3200
9 "	600	1200	2400
12 "	400	800	1600
18 "	300	600	1200
24 "	200	400	800
30 "	163	325	650
36 "	138	275	550
48 "	100	200	400

To pump to any other height, less or more, it is only necessary to effect a proportionate diminution or acceleration of the velocity of the piston. Thus, a piston 24 inches, revolving 800 times, would raise water 120 feet, but if it were driven at the rate of 1,600 revolutions, it would raise it to 480 feet.

In all ordinary pumps, as the pressure (or height) of the column increases, the loss by leakage, if the valves, valve-boxes, or pistons are not perfectly tight, also increases proportionately; and if they are, the friction is so great as to consume the principal part of the power employed, leaving but little for efficient action on the rising column. This difficulty is overcome in the pump now before us, and the flow of its jet being continuous, the loss of power by inertia is prevented, as well as great wear and derangement of machinery, caused by the incessant shocks which, in the use of reciprocating pumps, are unavoidable, notwithstanding the attachment of large and costly air-vessels—appliances which are wholly dispensed with in this pump. All rotatory pumps, working with surfaces in contact, are speedily destroyed by sand, mud, or other foreign matters in the water; but none of these cause injury to this pump. The larger sizes will admit the passage of solid substances of 1½ inches in diameter, and others in proportion. Those designed for vessels, are so arranged as not to be choked by corn, chips, raw turpentine, coal of small size, paper, pulp, sand, or other impeding substances.

We extract from the *Boston Post* (U.S.), the following particulars of a trial of the invention in the navy yard, before Commodore Downes, and other naval officers and scientific men:—

"We have witnessed some trials with steam power, and although the pump used is only one of the smaller sizes, it discharged a column of water eight inches in diameter, that being the size of the external conduit pipe. The surface of the water in the well from which it was raised was twenty-two feet below the pump-wheel. The quantity discharged in one minute was 1,500 gallons. It was also tried as a fire-engine with four butts playing at once. The hose-pipes from three were turned into the cellar, and the range of the fourth, which was turned into the yard, was found to be seventy-five feet. The nozzle was one inch and three-eighths, and the water was in as solid a form as it could possibly be in hose. In both trials, only the limited amount of seven horse power was applied. There seems to be no limit to the power of the machine, other than the maximum strength of the materials of which the parts are made, and the strength beyond which it is impossible to go in the construction of steam-engines. Ten thousand five hundred gallous per minute can be carried thirty feet high by a pump having discharge and suction-pipes each eighteen inches in diameter, wheel thirty-six inches in diameter, with eighty-four horse power. On account of the simplicity of the construction there is scarcely any loss of power from friction, and it is estimated that the discharge of water is fully equal to ninety per cent. of the driving power. As the discharge space is equal to the admission aperture, the pump can never become choked with sand or mud, or by any kind of floating debris; and it is confidently predicted that its introduction will effect a revolution in the business of raising water. The pump, according to size, may be applied to house use, factories, fire-engines, sailing vessels, or steam-ships, draining rice-fields, mines, quarries, floating docks, dry docks and canals, water-works, &c., raising 100,000 gallons per minute, at any required elevation, with a sufficient degree of motive power. The size of the pump whose performance at the navy yard we have stated above, is only about 3½ feet square."

Our concluding table exhibits in detail the performance of various sizes of pumps, with the speeds and height to which the water is elevated:—

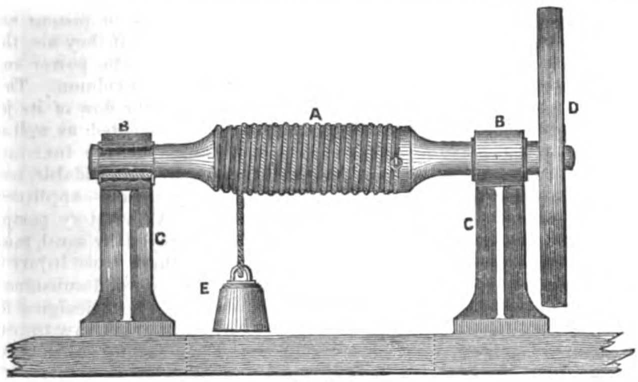
Size of Discharge Pipe.	Size of Suction Pipe.	Diameter of Piston.	Revolutions necessary to raise water 30 feet.	Horse power to raise that quantity of water 30 feet.	Gallons of water raised 30 feet high by each size with that number of revolutions.	Places and Purposes for which the Pumps, as arranged, are specially applicable.
Inches.	Inches.	Inches.	Revolutions.	Horse Power	Gallons.	
1	1½	6	1600	⅛	25	Dwelling-houses and farm-yards.
1½	2	9	1200	$\frac{4}{8}$	100	Paper and fulling-mills.
2	3	12	800	2	250	Manufactories, tanneries, ships, sloops, boats.
3	4	18	600	4	500	
4	5	24	400	8	1000	
6	7	30	325	16	2000	Large cotton-mills, steam-ships, and for supplying water to cities and towns.
9	10	36	275	36	4000	
12	13	36	275	44	5000	
6	7	12	800	10	1200	Drainage and irrigation works, dry-docks, canals.
12	13	24	400	40	5000	
18	20	36	275	84	10,500	
1½	2	9	1200	4 men.	100	Garden and house engines.
3	4	18	600	16 men.	250	Villages and plantations.
4	6	48	200	50 men.	1000	Large cities.

SINCLAIR'S OIL-TEST.

Mr. Sinclair, the locomotive superintendent of the Caledonian railway, has for sometime employed an apparatus of this class which deserves making known amongst practical men for its simplicity and cheapness. The annexed engraving exhibits a side elevation of the test. A short horizontal spindle, A, has end journals carefully turned upon it, to run in brass bearings, B, in the tops of the two brackets or pedestals, C. The shaft carries on one end a smooth fly-wheel, D, to give it an impetus when set in motion.

The central portion of the spindle is increased in thickness, to form a barrel, which is turned with a spiral groove to receive a length of $\frac{3}{10}$ths

or $\frac{1}{4}$th inch gut or cord. One end of this cord is attached to the barrel by a loop passed over a short straight pin in the barrel, whilst to the opposite end is hung the weight, E. The oil to be tried is laid on the two journals, and the cord being looped on, and the weight wound up, the latter is allowed to descend freely, the cord becoming readily dis-



1-12th.

engaged from the pin when run off. The quality of the oil is determined by the length of time which the shaft revolves. This is readily ascertained by the seconds-hand of a watch, and does away with the necessity for any other indicating apparatus. In this respect it presents considerable superiority over Mr. Thomas' test, figured by us at page 273 of our first volume.

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RECENT PATENTS.

MANUFACTURING AND PRINTING CARPETS.

W. Melville, *Roebank Works, Renfrewshire.—Enrolled July* 11, 1851.

The very valuable improvements embodied under this patent refer:—

1st. To a system of throwing or actuating the needle, or other apparatus of a similar nature, used in weaving carpets and other looped fabrics, for raising or forming the loop or pile.

2d. To a modification of a needle or wire, for weaving either single or double fabrics, which modification the patentee terms a contracting needle, the object of such contrivance being the facilitating the withdrawal of the needle from the fabric being woven.

3d. To a novel form of double reed, to be worked in connection with two shuttles, wherein the dents of such reed are notched, or formed with a step for carrying the upper shuttle, in place of allowing the latter to traverse across the warp.

4th. To a mode of printing yarns, or other materials or fabrics, by means of surface-rollers or cylinders, revolving or dipping into colour troughs.

5th. To a novel arrangement or construction of printing-rollers, or cylinders, to allow of the variation of the pattern or device thereon.

6th. To a system or mode of regulating the tension of yarn during printing, by means of a permeable fabric, working either in connection with or without a waterproof fabric or blanket.

7th. To a system or mode of printing woven fabrics without the use of an upper impression-roller or surface-blanket.

8th. To the steaming of printed yarns directly, as they pass from the printing machine.

Mr. Melville exhibits his needle action as applied to a loom for weaving a double-pile fabric, to be afterwards cut in two, to form two distinct pieces; but the same plan is applicable to single weaving. Six treadles are used in this loom, the two central ones of the row being employed to work the two sheds for the warp threads of the backs; the next pair outside the central ones for the wool to form the loop; and the outside pair for actuating the loop needles. Instead of using an extensive series of needles, the inventor effects all the necessary actions with a single pair, worked alternately from each side of the piece by a treadle and pulley action.

The improved form of the needle consists of a couple of bars hinged together by transverse links like a parallel ruler. Each time that the needle is thrown to form the loop, a catch on the upper side being pressed by the movement, expands the needle to its full extent, and, when withdrawn from the pile, the frictional action of the latter tends to hold back the moveable bar, and thus contracts the needle's width, enabling it to pass freely from the web. The double reed is made with very broad dents, each having a projecting ledge, so that the whole range forms a race for the upper shuttle, the lower one being traversed along the ordinary race below.

The most important feature of the invention refers to a mode of printing yarns by the use of wire-cloth, or other permeable fabric, for holding the yarn firm and giving it a uniform tension, whilst the colour is pressed through the permeable fabric upon the yarn. The layer of yarn is held between the wire-cloth on the lower side, and a blanket on the upper one, the colour being carried up from troughs below by surface rollers, and pressed against the lower side of the wire-cloth, through which it percolates and passes to the yarn. The yarn has thus a firm body, and may be printed with as much facility as a woven fabric. Mr. Melville describes his machine as delivering the printed yarn into a case for the subsequent steaming process; but he mentions that he also proposes to pass it at once over a steam jet or perforated pipe, and thus effect that operation directly, as the yarn is printed. The surfaces of the printing rollers are formed in divisions or segmental pieces, fitted to slide in grooves in the metal end-pieces carried by the roller shafts. By this means any single division may be removed and varied at pleasure. In producing the printing surface, a plain roller of the exact diameter required for the extent of the pattern, is covered with a layer of gutta percha, and over this layer is placed a thickness of flannel. On this the device is drawn, and the portions for the several separate colours being cut out and taken off this matrix-roller, are placed on their respective printing-rollers, which are checked to correspond to the matrix, so that the utmost accuracy of arrangement is insured with facility. Instead of using a surface-blanket, the patentee proposes to dispense with it altogether, by using upper or counter-pressure rollers, formed with a pattern to correspond to the printing-rollers. He also illustrates a plan for printing woven fabrics by surface-rollers by the resist process, the device being impressed upon the fabric by the tension of the fabric itself in passing over the surface impression roller.

CAST-IRON PAVING.

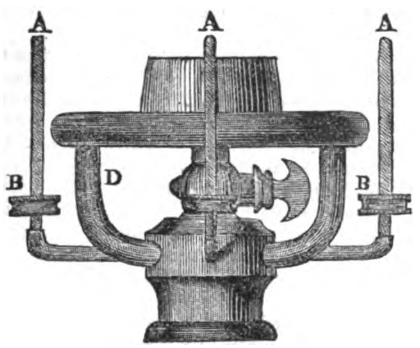
Thomas Allan, *Glasgow. Enrolled July* 11, 1851.

Mr. Allan's improvements relate to the application of cast-iron as a substitute for the ordinary materials used in paving streets and footways. He delineates various patterns of plates for this purpose, the faces being made to resemble ordinary dressed paving. In laying down paving of this class, no other preparation is necessary beyond giving a firm and even substratum of concrete or sand; but, in order to connect a series of the plates together, so as to render any single one immoveable except by commencing at the edge of the paving—as well as to give the whole set a mutual bearing, one upon the other—the parallel edges of each plate are cast with corresponding flanges. These flanges are so arranged that one pair of parallel edges shall have lower, or base flanges, whilst the other parallel pair has similar flanges above, the plates being laid so that the upper flanges on one shall coincide with the lower ones on the next to it. Various figures, or surface devices are shown, all being contrived so as to afford secure foot-hold for horses. The footpaths are formed of very thin plates, similarly adjusted, and having small projecting squares on their surface, formed by a series of grooves intersecting each other at right angles, and the side channels between the roadways and the footpaths are also of cast-iron, having flanges as bearing surfaces on each side. In addition to this mode of paving with large plates, the same system is proposed to be carried out by using detached blocks, or hollow box pieces of cast-iron, to represent separate paving-stones. This

species of paving possesses a peculiar neatness and regularity of appearance, which cannot be obtained by the ordinary plan of paving with small detached stones. It is presumed, also, that its durability will be very great. This point is, we believe, now being tested by public use in various localities, and under severe ordeals.

COMPOUND CONCENTRIC GAS-BURNER.

Fig. 1.



Registered for Mr. D. Hulett, *Holborn, London.*

Mr. Hulett's compound burner comprehends two specific points of improvement—the combination of the argand with the concentric form of burner—and the addition of adjusting screws to the brackets or branches, for the regulation of the height of the glass. Fig. 1, of our engravings, is an elevation of the burner; and, fig. 2 is a corresponding plan. The screwed branches, A, act both as guides and supports for the glass, by means of the adjustable milled nuts, B, which may be screwed up or down, to raise or lower the glass, at pleasure. The portions, C, D, indicate the combined burners; which are stated, by the inventor, to give a much better light than either the argand or the concentric separately.

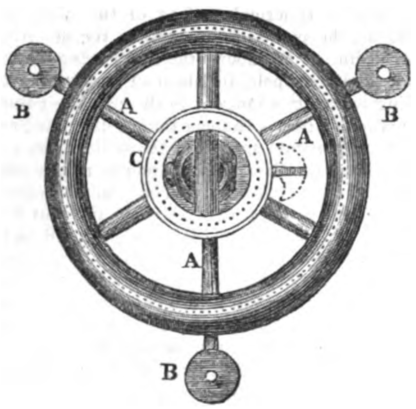


Fig. 2.

CORK JACKET, OR LIFE-PRESERVER.

Registered for Mr. J. D. Caulcher, *Anstruther Villa, London.*

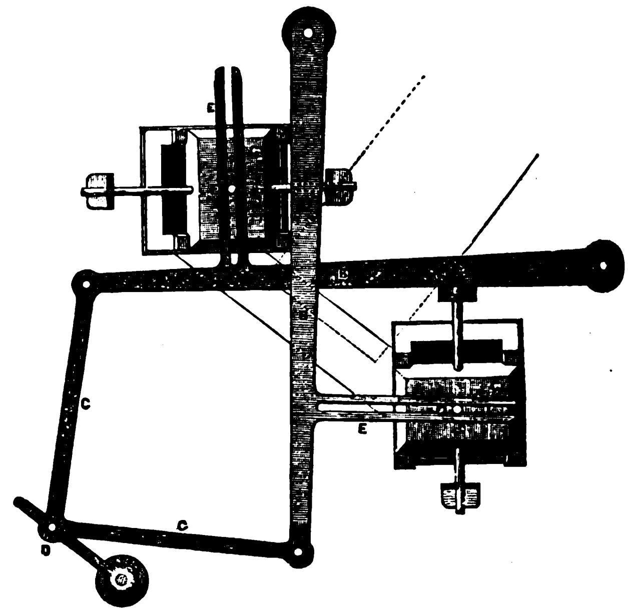
Instead of attaching large pieces of cork to the jacket, as is usually done, Mr. Caulcher employs a scientifically arranged set of cells filled with cork fibre, and jointed together, so that great elasticity is secured, and the comfort of the wearer is proportionately increased. These cells are attached to the inside of the jacket by sewing, the plan being equally applicable to ladies' as to gentlemen's apparel.

When worn as a life-preserver, the lower portion is folded up and fastened in front by a hook and eye; and thus a superior amount of buoyancy is given to the upper part of the person when immersed in the water. An adjustable cord, arranged to pass round the neck, answers as a simple means for elevating the part to be folded up. The increased flexibility gained by Mr. Caulcher's plan, is certainly an improvement upon the old stiff form of life-preservers.

APPARATUS FOR WORKING VALVES OF DRY GAS-METERS.

Registered for Mr. D. Hulett, *Holborn, London.*

The point arrived at by Mr. Hulett in this design, is the simplification of the valve-action of meters of the dry, flexible-chamber kind. Our engraving represents a plan of the movement. The centres, A, are the axes of two flexible diaphragms, working in the ordinary way. These axes carry lever-arms, B, which are connected at their opposite ends by the links, C, to the nut of an adjustable crank, D, which governs the movement of the arm. On the latter are formed horns or slotted-guides, E, for the reception of stud-pins, F, fast on the slide-valves, G. It is easy to see how the movement of the crank, D, thus communicates motion to



the valves. The guides, E, which constitute the novelty of the apparatus, afford a movement of great simplicity and accuracy.

REVIEWS OF NEW BOOKS.

Patentable Invention and Scientific Evidence. By W. Spence. 8vo. Pp. 102. London: Stevens & Norton. 1851.

Mr. Spence introduces his subject by stating that he does not intend to dwell upon the "vexata questio," of the mode of granting patents, their cost, and all the other details properly coming under the head of "Patent Practice;" but simply to treat the matters specially alluded to in his title. Whilst making this statement, he goes shortly into the subject of "little patents," by which he means patents at a small cost, and for a short period—to act, in fact, as a substitution for the great proportion of registrations now effected under the utility act, and which he rightly states to be placed in a false position by such registration. Whilst upon this subject he quotes a passage from Mr. Carpmael's "Treatise upon the Designs Act," which broadly states that such articles as the Designs Act will protect, can not be valid subjects for letters patent; and, on the contrary, that anything patentable cannot be efficiently protected by registration.

This dictum, in the truth of which we never agreed, has, however, since the publication of Mr. Spence's book, received a direct contradiction by the decision of Mr. Justice Patteson, on the case of Hodges v. Driver (reported shortly at page 21 of this volume), where, in giving judgment, it was distinctly stated that though the registeree might have protected his invention by letters patent, yet he was not precluded from contenting himself with the shorter protection of the Registration Act, and the validity of the registration was upheld.

It is very true that a very large proportion of the inventions at present registered are by no means efficiently protected under the act; but where a particular object is gained by a new configuration or shape, there is no valid objection to its being either registered or patented at the option of the inventor. The cheapness of the presumed protection, and the fact of the registration extending to the whole of the United Kingdom, induce many inventors to seek a fallacious protection under the act, for inventions which they are often afterwards desirous to patent when the true value of the invention is arrived at.

Mr. Spence seems to have intended his work for the purpose of inducing the formation of a calm opinion upon the patent laws as they at present stand, and to be a check on what he properly terms "the temporary feeling of excitement for the present, unwholesomely stimulated by the Great Exhibition." He says, "it is due to patent property that

the legal foundation on which it rests should not be disturbed to meet a popular cry, which, like its predecessors, will only have its day." What would he have said to the recent discussion in the House of Lords, where the actual abolition of patent privileges was mooted, and to the effect of the new bill passed by the Lords, and now with the Commons, where the colonies are excluded from future patents—a step of itself merely absurd, were it not that it appears to be a stepping-stone to the entire abolition of all protection to inventors.

Mr. Spence divides his book into three divisions. Patentable invention, in the terms of the original statute, is "any manner of new manufacture," under which he argues, with good sense, that the "one realm" should be covered by one patent.

"Patentable invention, as interpreted by the authorities, is an embodied principle," and "Scientific evidence," which he again treats under the heads of—1st. Nature of inquiry in patent cases; 2d. Brief statement of the law as to the admissibility of scientific evidence; 3d. Comparison of present practice with the foregoing statement of the law; and 4th. Suggestions of improvements in practice.

On the whole, we have perused Mr. Spence's work with much interest, and can recommend its examination to such of our readers as feel interested in the Patent Laws and their "coming reform," as a work in which they will find the present position of patent property sensibly reviewed, and interspersed with many judicious observations on the contemplated alterations.

CORRESPONDENCE.

THE ROTATION OF THE EARTH.

Having now endeavoured to explain the nature and cause of the deviation of the pendulum at the poles of the earth, let us now consider the effect at the different latitudes;—and, to proceed by degrees, let us recede from the pole only a short distance at first, say 15 miles, so that, without any material error, we may abstract from the sphericity of the earth, and consider the space between us and the pole as a plane; and suppose, as before, the pendulum hanging freely by its point of suspension, and without any oscillation communicated to it. The point of suspension and the cord and ball will no longer, by the earth's rotation, turn round their centres, leaving the centre of gravity at rest: they no longer coincide with the earth's axis, but are removed from it 15 miles. By the earth's rotation, therefore, they will all, and the centre of gravity along with them, be made to revolve at this distance round the pole as a centre, having no longer a rotatory but a progressive motion, combined with a circular motion, in the circumference of a circle or parallel of latitude 30 miles in diameter, turning like a sling round the finger which holds it, the horizontal plane of the spectator being at right angles to the earth's axis of rotation.

In these circumstances, let the pendulum be set to oscillate, as before, in the plane of the meridian, and what will be the effect? It is evident, by the great law of inertia, that the point of suspension, the cord, and the ball, all participating in the same motion, and progressing as one mass, this general motion of the system cannot interfere with any partial movement within it. The oscillation of the pendulum, therefore, proceeding as if the whole mass had been at rest, must continue in the same direction precisely as it began. The ball, it is true, will not, and cannot go in the same identical plane of the meridian as it did when at the pole; the plane of oscillation will be carried successively through different planes, and every instant in a new plane directed to a different point in the space beyond the earth; but the effect of the law of inertia will be to keep these planes all parallel to the first and to one another, so that while the ball of the pendulum, the cord, and point of suspension, and all around them in the room, are carried in a mass round the circle of revolution, taking the meridian line along with them, and giving it a rotatory or angular motion, yet the plane of oscillation of the ball continuing inflexibly parallel to itself, having a progressive but no angular motion, this will cause a deviation in the relative positions of the meridian line on the floor and the line in which the ball oscillates. The latter, no doubt, appears in the experiment to deviate from the meridian, turning gradually to the right or left, but it is the floor itself, and the meridian line attached to it, which in reality turns by the earth's rotation, while the plane of oscillation of the pendulum stands still. The relative motions are exactly such as we would observe, if we were to hang a small plummet to the extremity of the hour-hand of a clock; the hand goes round in twelve hours, but the plummet, though carried round with it—yet, as it hangs always perpendicular, having no angular motion—after coinciding with the hand at twelve o'clock, it gradually separates and appears to deviate from it, till at three it is at right angles, and at six again coincides; the hand being carried successively through lines all directed to the centre of the dial, while the plummet is carried successively through different lines, but all parallel to the first and to each other. Or take another case, where the plane of rotation is horizontal: take a compass, and carry it slowly round on the circumference of a round table; the needle, keeping always in one direction, is carried through lines all parallel to one another, while the dial at the circumference of the table is carried round the centre, by which its north and south line makes a complete revolution, causing the needle apparently to move round to every point in the compass, while it is the dial itself that is turning, and the needle remaining, as to parallelism or angular motion, perfectly at rest.

So it is with a spectator on the earth's surface near the pole, as we have supposed. He, along with the floor on which he stands, is carried round the pole as round a centre, and the line which joins him with the pole, and coincides in this case with the meridian line itself on the floor, this line turns round the pole exactly like the hand of a clock or watch, once in twenty-four hours. But not so the plane of oscillation of the pendulum, or the line marked out by it on the floor. This coincides with the meridian at the commencement, but no longer; while the meridian line, always directed to the pole, turns round it continually like the spoke of a wheel, the line of oscillation stands still, and hence arises the deviation between them, which must evidently be at the rate of a whole revolution in twenty-four hours.

However far, therefore, we were to recede from the pole, if we could only abstract from the sphericity of the earth, and conceive the horizontal plane at right angles to the earth's axis of rotation, the period of the pendulum's revolution would be the same. But here is the element that changes the law of revolution: as we recede from the pole—not on a plane surface, but on the actual spherical surface of the globe, on which, as we recede southwards, the plane of our horizon recedes with us, and the horizontal meridian line on the floor—the line joining, as we have supposed, the spectator with the pole, in place of continuing to direct itself to the pole—being in reality a tangent to the sphere—points to a situation beyond the earth, and comes to meet the earth's axis prolonged in a point more and more removed from and above the pole, the farther south we go; and it is round this distant point, and no more round the pole itself, that the meridian line comes to revolve; and the more distant this point is, the more slowly does the meridian line revolve round it, and the less, therefore, will be the deviation of the pendulum in twenty-four hours, and the longer in turning wholly round. The horizontal plane of the spectator being no longer at right angles to the axis of rotation, but oblique to it, the meridian line is also oblique, and turns, like the teeth of a bevelled wheel on the surface of a cone, having for its base the parallel of latitude, and for its apex the distant centre in the earth's axis prolonged. In this way the meridian line, with which alone the oscillation of the pendulum is compared, and which at and near the pole is affected by rotatory motion only, comes in receding from the pole, and turning on a conical surface, to partake partly of parallel or progressive motion, which has no effect on the pendulum keeping always parallel with it, and partly of rotatory motion, by which alone any deviation is produced; and in proportion as the influence of the former on the deviation is withdrawn, the influence of the latter is diminished. Now, the more we recede from the pole southwards, the farther off do we send the distant centre of rotation in the earth's axis prolonged, and the longer and sharper and more oblique do we make the cone of revolution, until we approach the extreme limit of the equator itself, where the horizontal line of the meridian, being parallel to the earth's axis, cannot meet it, let it be ever so far prolonged. The cone, therefore, becomes infinitely elongated, and passes into a cylinder circumscribing the earth at the equator, and on the surface of which the meridian line is now carried by parallel or progressive motion alone, and all rotatory motion ceases. The meridian line on the surface of this cylinder travels successively through different lines, but they are all parallel to one another. The horizontal line of oscillation of the pendulum, again, being carried in like manner, and by the same motion, through lines all parallel, and on the surface in fact of the same cylinder, the two lines must remain always coincident, and no deviation can occur.

Thus we see clearly the nature of the two extreme cases of this phenomenon. At the pole itself the plane and line of oscillation remains fixed, and the meridian line turns by simple rotatory motion round the axis of suspension in twenty-four hours, causing a deviation of one revolution in the same time. The moment we recede from the pole, the pendulum acquires a progressive and circular motion, but still neither of these appear to affect the parallelism of the line of vibration. The meridian line, however, requires a slight and gradually increasing parallel motion combined with its rotation—and this effect is most material, and appears, indeed, the only material element in diminishing the rate of deviation,

and prolonging the time of its revolution; and this goes on as we recede from the pole, the parallelism increasing and the rotatory motion diminishing, till at the equator the latter ceases altogether, and, leaving the former predominant, the meridian line becomes parallel as well as the lines of vibration, and both go on together, and no separation during their whole circuit round the globe.

Between these extremes, the law of progression is easily deduced by considering only the conical surface described by the meridian line in different latitudes. The elongation of the cone as we advance southwards becomes a measure of the prolongation of the time of the pendulum's revolution; and if we take the radius, or half the breadth of the base of the cone, in any latitude, to represent the earth's revolution in twenty-four hours, the side of the cone will give the time of the pendulum's revolution in that latitude; or, on the other hand, if we wish the rate of the hourly motion, this is represented by the radius of the base, and that of the earth's rotation by the length of the cone. And, mathematically speaking, it is evident, as the half of the angle at the apex of the cone is the latitude of the place, that the length of the side of the cone is to half the breadth of the base, as radius to the sine of the latitude. A simple rule, and one in which all mathematicians appear to agree.

We have hitherto only considered the case of the pendulum swinging in the meridian; but in whatever line, either east and west or otherwise, the vibration is performed, the same principles are involved, and regulate the effects by the same rules. Much more might be said on this interesting subject; and some difficulties remain to be cleared up, and particularly how to conceive the possibility of the pendular deviation in the latitudes going on increasing from day to day, while all the circumstances of the earth's motion are brought back, and again repeated every day. But the explanation of this must be referred to another opportunity. In regard to the observation of your correspondent, that the pendulum indicates a deviation when at rest, I do not think this, if it exists, could be at all sensible to ordinary observation, and I am not aware of the fact having been observed among mechanics.

Geo. Buchanan.

14 *Duke Street, Edinburgh.*

DOUBLE EXPANSION STEAM-ENGINES.

I have to express very considerable surprise at the appearance of Mr. Sims' letter on this subject in the July part of the *Practical Mechanic's Journal*, and must say that I think the writer either does not fully understand the principle of my plan of engine, or will not acknowledge the improvement involved in it. To make the matter perfectly clear, I will, however, enter a little further into its details. My large cylinder is one-fourth less in area than that of Mr. Sims, therefore its first cost is much less, and from the reduced size of the piston, it is obvious that its friction will be diminished in like ratio, whilst it is equally evident there is less dead weight to be moved in it. By returning the steam to the upper side of the small piston, I produce a higher uniform temperature. Now, a high temperature in the cylinder effects a saving in steam, from a smaller volume being swallowed up when the slide opens the passage from the boiler for the up-stroke. In all engines there is great loss of steam by escape past the piston; hence, as my large piston is less in circumference than that of Mr. Sims, there is so much less chance of loss in this respect.

My small piston and stuffing-box loses no steam at all, as the same temperature and pressure exists on each side. I may also remind Mr. Sims, that I have all the advantages attendant upon a single slide valve, and short ports, as described by "Aladdin," in his interesting letter at page 89. As my sketch at page 43, shows its pistons at the same point of stroke as Mr. Sims', in your plate 52, your readers may easily deduce their own comparisons—as the large piston is acting in each figure—and the necessary calculations are too simple to call for illustration here.

Mr. Sims tries to show that I lose one-fourth of the effective pressure of the steam, by having two cylinders full of steam at once; whilst, at the same time, he admits that the vacuum is the same in each. Now, it is difficult to see how there can be any loss or gain of effective pressure at the termination of the stroke, as the sooner we get rid of the steam after this point the better.

I may add, that "Aladdin" has forgotten the effect of the atmospheric pressure inside the trunk, in causing so much irregularity of motion in engines worked expansively like that of Mr. Sims. I had the same thing drawn out at the time I sent you my sketch, but gave it up on finding that the pressure of the atmosphere counterpoised the piston, long before the termination of the up-stroke.

Alexander Morton.

Dundee, July, 1851.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

MEETING OF THE BRITISH ASSOCIATION AT IPSWICH.

Wednesday, July 2.

G. B. Airey, the Astronomer Royal, President—The Report of the Council and the General Treasurer's account were read. By the latter it appeared that 1,783*l.* 1s. 3d. had been received, and 1,669*l.* 7s. 7d. expended; leaving a balance in the Treasurer's hands of 113*l.* 13s. 8d.

ABSTRACT OF THE PRESIDENT'S ADDRESS.

The progress of astronomy in the last year has been very great. The Earl of Rosse has been much engaged in experiments on the best methods of supporting and using his large mirrors. The construction adopted some time since is still retained;—namely, a system of levers distributing their pressures uniformly over eighty-one points, each pressure being transmitted through a small ball which permits to the mirror perfect freedom of slipping in its own plane, so as to take proper bearing in the chain or hoop which supports it edgeways. To Lord Rosse's critical eye the effect even of this mounting, though greatly superior to that of any preceding, is not quite perfect. In the progress of the experiments, some singular results have been obtained as to the set which a metal so hard as Lord Rosse's composition may receive from an unequal pressure of very short duration. A surface of silver, I believe, has now been successfully used for the small reflector. Of the character of the discoveries in nebulæ made with this instrument, I cannot briefly give any very correct idea. The most remarkable is, the discovery of new instances of spirally-arranged nebulæ; but there are also some striking examples of dark holes in bright matter, dark clefts in bright rays, and resolvability of apparently nebulous matter into stars. I do not deny the importance of the last observation; but as it might be predicted beforehand that the increase in the dimensions of telescopes would lead to no more resolution of nebulæ, I do not hold the inference to be by any means certain that all nebulæ are resolvable. Mr. Lassell exhibited at the last meeting of the Association, a plan for supporting his two-feet mirrors without flexure. This plan, slightly modified, has been adopted in use; and I am assured that the improvement in what before seemed almost perfect definition is very great. The removal of the vexatious fiscal interferences with the manufacture of glass, and the enterprise with which Mr. Chance, as manufacturer, and Mr. Simms and Mr. Ross, as opticians, have taken up the construction of large object-glasses, promise to lead to the most gratifying results. Already Mr. Simms has partially tested object-glasses of 13 inches aperture; and one of 16 inches is waiting not for the flint but for the crown lens. Mr. Ross, it is understood, has ground an object-glass of 2 feet aperture; but it has not been tested. The facility of procuring large object-glasses will, undoubtedly, lead to the extensive construction of graduated instruments on a larger scale than before; and it is in this view that I contemplate, as a matter of no small importance, the erection (this year) of the large transit-circle at the Royal Observatory at Greenwich. It is known to many members of the Association that this instrument was constructed in this town, by Messrs. Ransomes and May; and for the admirable proportions of its various parts, for the firmness of fitting of the few portions of which it is composed, and for the accuracy of the external forms of pivots, &c., it may well be considered as one of the finest specimens of engineering that has ever been produced. As an example of an excellent mechanical structure carrying a large object-glass, I think it probable that this Greenwich transit-circle may have a great influence on the construction of future instruments. I had hoped to be able by this time to report to the Association on the American method of recording transits, by a puncture or dot produced by a galvanic agency whose circuit is closed by a touch of the observer's finger,—and especially on its fitness for the wants of a really active observatory; but the delays of construction have prevented me from doing so. Shortly before the last meeting of the Association, the President for the time (Dr. Robinson) transmitted to the Government, on the part of the Association, a general request that a large reflecting telescope might be sent to some of the British possessions in the southern hemisphere, for the purpose of observing the southern nebulæ; and shortly after that meeting an answer was received from the Lords of the Treasury, to the effect that their lordships entirely recognized the importance of the object, but that there appeared to be practical difficulties in the immediate execution of the design. I cannot doubt that when a more explicit plan has been formed, another representation will be accompanied with the same success which has attended every application made by the Association for aid in a carefully arranged design. It will be interesting to the Association to learn that the continuation of the observations on α Centauri at the Cape of Good Hope has fully confirmed the result first obtained,—namely, that the parallax of that star exceeds nine-tenths of a second, or that its distance from the sun is about twenty billions of miles. So far as we have the means of judging, this star is our nearest neighbour in the sidereal spaces. The attention of foreign astronomers is still directed to the irregularities in the proper motions of stars, and the opinion seems to be gaining ground that many of them are accompanied by non-luminous companions. In our own solar system, the most remarkable discovery is that (made independently, though on different days, in America and in England) of a dusky ring interior to the well known rings of Saturn. It now appears that it had been seen several years before; but it then attracted no attention. How such a ring is composed, and how sustained, are questions upon which perhaps the physical astronomer may long employ himself. But the discovery for which the year will be most frequently cited is that of three additional planets, included in the same planetary space—between Mars and Jupiter—in which eleven others had been previously found. The last of these (Irene) discovered by Mr. Hind, observer in the private observatory of Mr. Bishop, forms the fourth of his list,—and makes his number the greatest that any one man has ever discovered.

Some time since, a grant was made by the British Government for the perfection of the Lunar Theory and the Lunar Tables on which Prof. Hanson, of Gotha, had been engaged, but whose progress was stopped by the interruption of funds in consequence of the unhappy Schleswig-Holstein war. I understand that with the aid of this grant, equally honourable to the British Government and to the foreign philosopher, the work is now rapidly advancing. I have reason to believe that the theories of Uranus and Neptune are now undergoing careful revision; and I trust that one of the elements most urgently required, namely, the mass of Neptune, will be supplied from observations of Neptune's satellite, made with the large telescopes to which I have alluded.

Among subjects related in some measure to astronomy, I may first allude to M. Foucault's experiment on the rotation of the plane of a simple pendulum's vibration; an experiment which has excited very great attention both in France and in England, as visibly proving, if proof were necessary, the rotation of the earth. It is certain that M. Foucault's theory is correct; but it is also certain that careful adjustments, or measures of defect of adjustment, are necessary to justify the deduction of any valid inference. For want of these the experiment has sometimes failed.

The next subject to which the influence of the Association was energetically directed is terrestrial magnetism; with which meteorology has usually been associated. Although the active employment of several of the colonial magnetic and meteorological observatories has terminated (those only of Toronto, Hobartown, Cape of Good Hope, Madras, and Bombay, being retained, and only in partial activity), the work connected with them has not yet ceased. Much has yet to be done in the printing and discussion of the observations—a work going on under the care of Col. Sabine. In tacit association with the representative of the government, the agents of the Association are employed at the Kew Observatory, under the superintendence of Mr. Ronalds, in devising or examining new instruments. The daguerreotype method of self-registration (which is perhaps liable to this objection, that the original records are destroyed), has been extended to the vertical-force instrument. Apparatus has been arranged for the graduation of original thermometers—a subject to which the attention of M. Regnault and Mr. Sheepshanks had been advantageously directed. And, with the assistance of a portion of the sum placed by the Government at the disposal of the Royal Society (to which I shall hereafter refer), it is hoped by the officers of the Association that the Kew Observatory will be made really efficient for the testing of new instruments. Dr. Robinson's very instructive account of his new anemometer has lately been received: this instrument, however, has not yet been used in many places. Among the immediate deductions from magnetic observations, I may especially mention Col. Sabine's remarks on the periodical laws discoverable in disturbances apparently of the most irregular kind, and M. Kämtz's corrections of the Gaussian constants. Among the more distant results, there is nothing comparable to the experimental inquiries into the magnetic properties of oxygen, and especially into the variation of its power, made by Messrs. Faraday and Becquerel,—and the application of these results to the explanation of the phenomena, in almost all their varied forms, of so-called terrestrial magnetism. It is to the former of these philosophers that this great step in the explanation of obscure natural phenomena by inference from delicate experiments, is mainly or entirely due. Much, of course, remains to be done, before we can pronounce accurately how far this principle enables us to account, without reference to any other cause, for the regular changes, as well as for the capricious disturbances, in ordinary magnetism. I ought not to omit stating that such general explanation had long ago been suggested in a very remarkable paper by Mr. Christie; but the experiments actually applying to the magnetic properties of oxygen were unknown, and perhaps impossible, at that time. In the science of abstract magnetism, the distinction between paramagnetic and diamagnetic substances has been thoroughly worked out by Mr. Faraday, and is now received as one of the most remarkable laws of nature. In the related subject of galvanism, although much of detailed law has been established by the labours of the same great man and of others, it is difficult to fix upon any new law of general character. Experiments made in America seem to establish that the velocity of the galvanic current in iron wires of a certain size does not exceed fifteen or eighteen thousand miles per second: a much greater speed, however, is inferred by M. Fizeau, from the same experiments. The first part of an elaborate mathematical theory of magnetism, by Professor Thomson, has been published. In meteorology, some striking facts have been collected and arranged by Colonel Sykes in regard to India, by Messrs. Schlagentweit in regard to the Alps, and by M. Plantamour in the comparison of observations at Geneva and the Great St. Bernard; and some very unexpected facts have been extracted by M. Arago from the observations in a balloon ascent at Paris. The systematic collection of observations of luminous meteors, in reports by Professor Powell, printed in the volumes of the Association for the last two years, can scarcely fail to lead to some discovery of the origin and nature of those mysterious bodies.

In optics, two or three investigations of rather important character have, since the last meeting of the Association, attracted public attention. Experimental measures of the velocity of light in air and in water, made by MM. Foucault, Fizeau, and Brequet, with apparatus nearly similar to that employed long ago for analogous purposes by Mr. Wheatstone, appear to leave no doubt that the velocity in water is less than that in air,—a most important, and indeed critical, result in regard to theories of light. A remarkable investigation by Professor Stokes, when compared with experiment, seems to establish that the vibrations constituting polarized light are, as for other reasons was supposed by Fresnel, perpendicular to what is usually called the plane of polarization. Some optical theories which admitted formerly of very imperfect mathematical treatment have been brought under the dominion of analysis by Professor Stokes's powerful methods of investigation. A curious series of experiments on diffraction has been published by Lord Brougham; but they have at present no bearing on theory, as the theoretical calculations with which they must be confronted appear to be too difficult or too complicated for the present state of pure mathematics. The experiments of Jamin regarding the reflection of polarized light under peculiar circumstances appear to give support to the theoretical calculations of Cauchy, founded on a molecular hypothesis applied to the undulatory theory. And lastly, some curious experiments by Masson, Jamin, Prevostaye, and Desains, appear to show more fully, what had partially been shown by Professor Forbes, that radiant heat admits of polarization in all respects similar to that of light.

The subject of geology has always excited much interest in this Association. It is matter of congratulation that the Museum of Economic Geology is now established in a habitation as well as in a form which guarantee its permanent and useful existence. Among subjects bordering on practical geology, I may allude to the late inquiries respecting the supply of water from the chalk and Bagshot sand districts as likely to give valuable information. In speculative geology, the labours of European as well as American geologists have been continued with their usual ardour, and there are now comparatively few parts of the world which have not been in some degree geologically examined. Far be it from me to pretend to assign with exactness specific discoveries (in observation or in inference) to specific persons; to say precisely what has been done by Sedgwick, what by Murchison, what by Lyell, what by Verneuil,—or even to state with accuracy what discoveries in the aggregate have been made by all. So far, however, as I can gather, the principal step made (not in the last year but in the last few years) has been of this kind. The line between the chalk group and the lowest tertiary or Eocene group has been drawn with great distinctness; and this has been done rather by palæontological criteria than by reasonings from order of superposition, &c. A very great step has been made in the classification of the geology of Asia Minor, with the aid of this new light, by a foreign geologist, M. Tchichachiff, now present. In the course of these investigations, attention has been drawn to the magnitude of the disturbances exhibited in these comparatively-modern beds; and the question has again been raised in the minds of geologists, whether these disturbances can be referred to causes now in action. It would be wrong, however, even in this hasty glance, to omit to notice the discovery of traces of the tortoise in beds so low as the lowest Silurian rocks, affording (apparently) evidence of the existence of this animal at a much earlier time than had usually been ascribed to it. I should be sorry also to make no reference to Sir C. Lyell's calculation of the time of formation of the delta of the Mississippi—or to Professor J. Forbes's paper on the modern extinct volcanos of the Vivarais. I may refer with satisfaction to Mr. Mallet's elaborate "First Report on Earthquake Phenomena," shortly to be followed, I trust, by a second; and I may also remind my hearers that the Association have supplied funds for the construction of a machine for earthquake registration, of which the superintendence is intrusted to the same gentleman.

On zoology and animal physiology I can scarcely venture to offer you a report, beyond a reference to the three papers on marine zoology in our last volume—which I conceive to possess the very highest value. I cannot, however, omit all notice of the last electro-physiological investigations of Signor Matteucci—investigations which seem to draw more closely the relations of inorganic matter with organic and animated structure than any others with which I am acquainted.

In vegetable physiology I must speak in a manner equally undecided. But I need scarcely allude to the interest excited among botanists by the return of Dr. Hooker from his botanical expedition of some years' duration into Upper India and Thibet—an expedition accompanied with great personal danger (for the botanist was for some time detained as captive by one of the native princes), and in which, moreover, the physical geography of a large and hitherto unknown region has been established. In the course of this expedition, a peak 28,000 feet high was climbed. In European botany the inquiries into the reproduction of cryptogamous plants appear to have occupied the most prominent place.

Engineering and manufacturing science have always commanded a great share of the attention of this Association. The former, indeed, when it is made to include experiments on tides and analogous phenomena, becomes almost one of the cosmical instead of one of the constructive sciences. It would be an endless task for the most accomplished mechanic to attempt to describe to you the inventions which are constantly made in every part of manufacturing science. Confining myself to engineering science, I may state that in the present partial suspension of railway works, and since the great achievement of the raising of the Britannia Bridge, there appears to be little which has strongly fixed public attention. Considerable importance, however, is attached by engineers to some of the processes lately introduced—especially that of thrusting down an air-tight tube or elongated diving-bell, supplied with air at the proper pressure, by which men are enabled to perform any kind of work under almost any circumstances, and in which men or materials may be transferred without disturbance of the apparatus, by a contrivance bearing the same relation to air which a common canal lock does to water. Improvements have also been made in the application of water-pressure to various mechanical purposes. Some years ago, an extensive inquiry into the practical uses and properties of various metals was made by a Committee appointed by the Board of Admiralty. It appeared to the Association a matter of great interest that the reports of this committee should be published; and, on their applying to the Admiralty, instructions were immediately given for placing the original reports in the hands of the Council of the Association. The Council have requested Mr. James Nasmyth to draw up an abstract of the principal contents of these reports; and this abstract, I hope, will be presented to the present meeting of the Association. Other reports, on important engineering subjects, for which requests were made by the General Committee at the Edinburgh meeting, will, I trust, be communicated to the present meeting. In treating of practical mechanics, I may perhaps, with propriety, allude to the investigations which have lately been made

by able engineers regarding the mechanical equivalent of heat. The subject, in this form, is yet new; but I think that the importance of an accurate determination cannot be overrated. This also appears the proper place for alluding to a subject which has attracted the attention of the Association from its very first formation—namely, the simplification of our Patent Laws. The measures of the Government, on more than one occasion, have shown that they are desirous of removing the impediment which, in this country (strange to say) more than in any other in the world, have been placed in the way of mechanical inventions.

Thursday.

The President in the Chair.

Section A.—Mathematical and Physical Science.

The following papers were read:—

"Experiments on the Conduction of Heat,"—Report made by Professor J. D. Forbes.

"On the Reports and Researches recommended by the Association from 1831 to 1848, in the Section of Mathematics and Physics," by Professor J. D. Forbes.

"On the Velocity of Sound in Liquid and Solid Bodies of limited dimensions, especially along Prismatic Masses of Liquid," by W. J. M. Rankine.

"On Mooring Ships in Revolving Gales," by Col. Reid.

"Description of an Apparatus for making Astronomical Observations by means of Electro-Magnetism," by G. P. and R. F. Bond, of the Cambridge (U.S.) Observatory.—The apparatus exhibited to the section is the same which has been in use at the Harvard Observatory, Cambridge, (U.S.), and is the property of the United States Coast Survey. It consists of an electric break-circuit clock, a galvanic battery of a single Grove's cup, and the spring governor, by which uniform motion is given to the paper. Two wires pass from the clock, one direct to the battery, and the other through the break-circuit key used by the observer, and through the recording magnet, back to the battery. The length of the wire is of course immaterial. When the battery is in connection, the circuit is broken by the pallet leaving the tooth of the wheel, and is restored at the instant of the beat of the clock, which is, in fact, the sound produced by the completion of the contact restoring the circuit—the passage of the current being through the pallet and the escapement-wheel alone. With the exception of the connecting wires, and the insulation of some parts, the clock is like those in common use for astronomical purposes. Several forms have been proposed by different persons, for interrupting, mechanically, the galvanic circuit at intervals precisely equal. In the present instance the clock is of the form proposed by Mr. Bond. Professor Wheatstone, Professor Mitchell, Dr. Locke, Mr. Saxton, and others, have contrived different modes of effecting this object—the former several years since, but for a purpose distinct from the present. The cylinder makes a single rotation in a minute. The second marks and the observations succeed each other in a continuous spiral. When a sheet is filled, and it is taken from the cylinder, the second marks and observations appear in parallel columns, as in a table of double entry, the minutes and seconds being the two arguments at the head and side of the sheet. The observer, with the break-circuit key in his hand or at his side, at the instant of the transit of a star over the wire of a telescope, touches the key with his finger. The record is made at the same instant on the paper, which may be at any distance, many hundred miles, if required, from the observer. It is a well-established fact, that not only may observations be increased in number by this process, but that the limits of error of each individual result are also narrowed. As far as comparisons have yet been made, the *personal* equation between different observers, if not entirely insensible, is at least confined to a few hundredths of a second. It is through the facilities and means furnished by the Coast Survey Department of the United States, under the superintendence of Dr. A. D. Bache, that individuals there have been enabled to bring to its present stage the application of electro-magnetism to the purposes of geodesy and of astronomy, it having been at the expense of that department, and frequently by its officers, that nearly all the experiments have been conducted.

Daguerrotypes of the moon were shown, taken by Messrs. Whiple and Jones, of Boston, from the image formed in the focus of the great equatorial of the Cambridge (U.S.) Observatory.

The Astronomer Royal said, that of course he felt the deepest interest in the subject of this communication. The principal of the method was entirely the discovery of the Americans, and Professor Bond had the merit of originating what he had no doubt would prove of the utmost importance in the practice of astronomy; for, besides the distraction of the attention of the observer at present having to listen to, and to count the beats of the clock, and having then to occupy many seconds in recording his observations when made—he could not often repeat these observations at as short intervals as would be desirable. But, by this method, he might even repeat an observation within the compass of one second if required. It was also believed that there was a more direct connexion between the senses of sight and touch—the senses that he required the aid of in this mode of observing—than there was between the senses of hearing and seeing, the senses called into united operation in the present mode of observing; and if this were so, what was at present known to practical observers under the name of personal equation would be got rid of—if not entirely, yet to a great degree. These and other considerations had made him determine to give this method of observing the most mature consideration, and the fullest trial. He had a cylinder constructed of twenty inches length and one foot diameter, and of which a fair conception of the size might be formed, when he stated that it would guage to about a bushel. This cylinder he hoped to be able to cause to revolve with something of an approach to astronomical uniformity. For this purpose, it was his intention to dispense with the fly-wheel which regulated the motion in Mr. Bond's apparatus, and to depend on a large conical pendulum revolving in a circle, the diameter of which would be about equal to the arc of vibration of an ordinary seconds pendulum. This, he intended, should be a well-made mercurial compensating pendulum; and thus he hoped to be able to dispense with the clock used by Mr. Bond. The construction of the conical pendulum he intended to use was also peculiar. He intended to take advantage of the principle of the chronometric governor of the steam-engine invented by a Prussian, and which the members of the section might see at work in Mr. Ransome's factory; but without such actual inspection, he feared he could not make himself understood in an attempt to explain this curious governor. Suffice it to say, that this governor was made to revolve by a bevil wheel, which engaged another bevil wheel attached to the governor, not directly, but through the intervention of a third, which worked upon a centre that was not entirely fixed. The moving of this intermediate wheel was made to work the valve which admitted or shut off steam, and thus equalize the motion of the machine as the resistance varied. In the apparatus he proposed to use, the resistance would occasionally vary from many causes, for instance, at the changing of the cylinder; and as this would affect the rate of the clock if not provided against, he proposed to use the principle of the foregoing governor, by causing it to produce a varying by moving further out or nearer to the fulcrum of a steelyard a weight, which would thus increase or diminish, as was requisite, the friction caused by a point connected with the steelyard on a wheel kept revolving by the machine. In this way he hoped to be able to produce a motion, which, under all changes to which the machine should be exposed, would remain uniform to the extreme accuracy required.

Mr. Bond exhibited daguerreotypes of the moon, taken with the 23-feet equatoreal of Cambridge (U.S.) Observatory.—These daguerreotypes were very beautiful, and admitted of being very considerably magnified. But Mr. Bond stated that the motion of the equatoreal, although very steady, was yet not sufficiently so to admit of their being examined by very high magnifying powers. Sir David Brewster stated that if these daguerreotype impressions were taken on transparent sheets of gelatine paper, and so placed before a telescope as to subtend accurately thirty minutes of a degree, they would assume all the appearance of the moon itself. He had also to state, that a discovery made by Mr. Fox Talbot within the last few days, would greatly enhance the accuracy with which such daguerreotypes as these could be produced.

"On the Rise and Fall of the Barometer," by Mr. W. H. B. Webster.—The object of this communication was to show that there was a compensation and reciprocation of temperature going on at distant places on the earth at the same time, and from time to time, and that the direction of the wind was determined by the relative rise and fall of the barometer, the current of air setting from the place where it stood high towards those where it stood low, and that heat and cold were the great moving causes in these changes, and not evaporation and condensation. These views were illustrated by several examples of the comparative heat and cold of the same days in polar regions and in London, and the course of the wind in tropical and temperate, arctic and equatorial places—and the manner in which these facts corroborated his views were pointed out.

"On a New Mode of Illuminating Opaque Objects under the highest powers of the Microscope," by C. Brooke.—A parallel pencil of rays is obtained by placing a camphine lamp (which, of all kinds of lamps, gives the most intense illumination) in the principal focus of a combination of two plano-convex lenses. This pencil is secured on the surface of a small parabolic mirror, the vortex of which is truncated, so that the focus of the mirror may be about 0·1 inch beyond the truncated edge. The rays which are converging to the focus are received on the surface of a small plane mirror which is attached to the bottom of the object-glass, so that the surface of this mirror may be nearly level with the lowest surface of the object-glass. All the rays of light which subtend any angle from that of the object-glass up to about 170° are thus rendered available for the illumination of the object; which, as it is illuminated by very oblique rays, must not be placed in a depression or cavity of any kind.

"On a New Arrangement for facilitating the Dissection and Drawing of Objects placed under the Microscope," by C. Brooke.—Two short pieces of tube, one of them the size of the eye-piece, the other the same size as the body of the microscope, are attached at an angle of about 4° to the sides of a brass box, containing a rectangular prism. The smaller tube enters the body of the microscope, and the larger screws the eye-piece. The image that enters the eye is now inverted in a plane, passing through the axis of the body and of the eye-piece; and in order to erect the image, a cap is placed over the eye-piece, to which is attached a small rectangular prism, having its axis in the plane in which the image is already inverted. This arrangement provides a very convenient position of the eye when the hands are engaged in manipulating an object placed under the microscope. A rectangular prism has already been introduced into the body of the microscope by Machez; but as this was placed near the object-glass, it must, to a certain extent, interfere with the definition of the objects. For the purpose of drawing, a small piece of parallel glass is substituted for the rectangular prism placed in front of the eye-piece, through which the drawing-paper is seen directly through two opposite surfaces, and the object is seen by reflection from an outer surface placed at an angle of about 45° with the axis of the eye-piece. The image inverted by the first reflection is again inverted in the same plane by the second; and is, therefore, correctly represented in the drawing.

Several members of the Section expressed their approval of these simple and effective contrivances; and Sir D. Brewster said that there were physiological reasons which rendered these contrivances for enabling a person to use the microscope with erect head important. When the eye was turned downward, in the first place, the fluid which works the cornea, and which during ordinary vision is spread in a uniform film over the cornea by the action of the cornea, and is constantly draining downwards over the cornea in the intervals, collects, when the eye is placed down-

wards, in a lenticular-shaped mass on the very centre of the cornea, so as greatly to impede vision:—and, moreover, those little fragmentary portions of the crystalline lens which, when it is breaking up, particularly in old age, become the elements of the *muscæ volitantes*—those which, in the erect position of the head by sinking down to the lower part of the lens, remain without interfering with vision—these, when the eye is turned down, collect in what is then the lowest and central part of the lens in the direct line of sight, and greatly impede the rays of light.

"On a new method of contracting the Fibres of Calico, and of obtaining on the Calico thus prepared Colours of much brilliancy," by Mr. Mercer, read by Dr. L. Playfair.—Mr. Mercer had his attention drawn to this subject by experiments made as early as 1844. Dr. Playfair briefly called attention to the states of water, the points of maximum density so well known, and the experiments of Mr. Mercer, who found that above this point water flowed more rapidly through a syphon than at the same number of degrees below this point of maximum density. He then spoke of the theoretical views of those chemists who look upon the combined water as in the state of ice, or free from fluidity.—Mr. Mercer's discovery may be stated in few words to be this: a solution of cold but caustic soda acts peculiarly upon cotton-fibre, immediately causing it to contract, and although the soda can be readily washed out, yet the fibre has undergone a change, and water will take its place and unite with the fibre. In a practical view, Mr. Mercer considered that the fibre might be considered by this action to have a sort of acid property to unite with soda and then with other bases. The effect of the condensation was said to be one-fifth to one-third of the total volume of cotton employed. Dr. Playfair then showed some proofs of the influence of this new process upon our cotton manufactures. Thus, taking a coarse cotton fabric and acting upon it by the proper solution of caustic soda, this could be made much finer in appearance; and if the finest calico made in England, known as 180 picks to the web, was thus acted upon, it immediately appeared as fine as 260 picks. Stockings of open weaving were shown, and the condensation process made them appear as of much finer texture. The effect of this alteration of texture was most strikingly shown by colours. The pink cotton velvet had its tint deepened to an intense degree by the condensation process. Printed calico, especially with colours hitherto applied with little satisfaction, as lilac, had strength and brilliancy, besides thus producing fabrics cheaply finer than can possibly be woven by hand. The effect was shown of patterns being formed by portions of a surface being protected by gum from condensation. Thus patterns of apparently fine work can easily be produced. It was stated that the fabrics by this process have much strength given them: for a string of calico one-half condensed by caustic soda will break by 20 oz., while the unacted-upon string of cotton broke with 13 oz.

A discussion ensued, by the remarks of Dr. Faraday, Mr. Warrington, Prof. Dumas, and others; and it was proposed that the microscope be employed to ascertain any other obvious change of properties by this new process, that bids fair to exercise an immediate and extensive alteration in the patterns and produce of cotton fabrics.—Dr. Playfair, in reply, said, that caustic soda had long been used for bleaching, but this power of altering the texture only belongs to the cold solution of caustic soda. These specimens were the only complete ones, and he had been permitted to bring them from the Great Exhibition to exhibit before the Association.

"On a Diamond Slab, supposed to have been cut from the Koh-i-Noor," by Dr. Beke.

Section C.—Geology and Physical Geography.

"On some tubular Cavities in the Coralline Crag, near Oxford," by S. V. Wood, Esq.

"On the Mechanical Structure of the Crag and London Clay," by J. Phillips, Esq.

Professor Owen exhibited and described a collection of mammalian remains from the Red Crag of Suffolk, submitted to him by Mr. G. Ransome.—The professor commenced by stating that the history of the tertiary period, and especially of the crag, had hitherto been deduced chiefly from the examination of the fossil shells contained in these formations. But since, as animals rise in the scale of nature, the diversity and importance of their modes of reacting upon surrounding media increase, together with their dependence upon external circumstances—the higher the class to which a fossil belongs, the greater should be the extent of information derivable from it as to the times and circumstances under which the species to which it belonged flourished. It is also a general rule, that the higher the class to which an animal belongs, the more restricted was its duration in past time. The whole tertiary series is much inferior in the number and thickness of its deposits to the secondary series; but whilst the genera *Ichthyosaurus* and *Plesiosaurus* range from the lias to the chalk, there is no known mammalian genus which extends through the tertiary system. Not fewer than 250 species of shells have been discovered in the red crag formation; but no higher organized fossils had been found associated with them than the teeth of fishes, until, in the year 1839, Sir Charles Lyell obtained evidence of a feline animal as large as a leopard, a bear of the size of *Ursus priscus*, a species of hog, and a ruminant. In 1840, Professor Owen determined the cetaceous character of a water-worn tooth obtained by Mr. John Brown from Felixstow; and in 1843, Professor Henslow obtained from the same locality a series of ear-bones (petro-tympanics) of whales, for which the term "cetotolites" was proposed. Believing these ear-bones and teeth to have belonged to the same genus of whales, one in which certain teeth that are rudimentarily and transitorily represented in existing true whales (*Balænidæ*) became fully developed and retained, Professor Owen had proposed for them the name of *Balænodon*. The discovery of the commercial value of the stratum in which these remains occurred has since caused it to be extensively quarried and examined. The formation of a museum of natural history in Ipswich has been the means of bringing together the materials for a much enlarged list of the mammalia of the red crag. Professor Owen concluded his report by inquiring whether the remains of the mastodon and rhinoceros had not been washed out of some miocene or older pliocene formation—while the horse, megaceros, bear, wolf, &c., belonged to the newer pliocene period? Professor Owen also stated, in reply to a question, that he regarded many of the so-called coprolites of the crag as nothing more than bones in various stages of organic degradation; he had not found in any of them the characteristics of true coprolite, namely, partially digested fragments of organized substances. Considerable discussion arose as to the age and origin of the mammalian remains. Professor Owen believed most of them to have been derived from an older formation, because the teeth were water-worn, and had lost their fangs, only the enamel-covered crowns remaining.

Section E.—Geography and Ethnology.

"Ethnological Researches in St. Domingo," by Sir R. Schomburgh.

M. Pierrie de Tchihatchef gave a summary notice of his explorations in Asia Minor.

Mr. Asa Whitney read *in extenso* his project for forming a communication by rail between the Atlantic and Pacific Oceans, and detailed the result to be obtained by the foundation of such a work. He also detailed his plan for rendering the undertaking self-productive and self-paying.

"On certain Races in India," by Dr. Young.

"On a projected Canal across the Isthmus of Darien," by Dr. Cullen.

Section F.—Statistics.

"An investigation into the question—Is there really a want of Capital in Ireland?" by Professor Hancock.—The Professor came to the conclusion that the supply of capital in Ireland is not deficient in proportion to the demand for it.—The reading of this paper was followed by a long discussion.

"On the Duties of the Public in respect to Charitable Savings Banks," by Professor Hancock.

ON BOILERS AND BOILER EXPLOSIONS.

By W. Fairbairn, Esq., F.R.S.*

The retaining force, or the thickness of the metal of a cylindrical boiler does not, however, increase in the same ratio as the area of the circle, but simply in the ratio of the diameter; consequently, the thickness of the metal will require to be increased in the same ratio as the diameter is increased. From this it appears that the tendency to rupture, by blowing out the ends of a cylindrical boiler, will not be greater in this direction than it is in any other direction; we may, therefore, safely conclude, since we have seen that the tendency to rupture increases in both directions in the ratio of the diameter, that any deviation from that law, as regards the thickness of the plates, would not increase the strength of the boiler.

I have been led to these inquiries from the circumstance, that Mr. Johnson appears to reason on the supposition that there are no joints in the plates, and that the tenacity of the iron is equal to 60,000 lbs., rather more than 26 tons to the square inch. Now we have shown by the results of the experiments already adduced, that ordinary boiler plates will not bear more than 23 tons to the square inch; and as nearly one-third of the material is punched out for the reception of the rivets, we must still further reduce the strength, and take 15 tons, or about 34,000 lbs.† on the square inch, as the tenacity of the material, or the pressure at which a boiler would burst.

This I should consider in practice as the maximum power of resistance of boiler plates in their riveted state, and I will now trouble you to follow me in a very concise, and, I trust, not uninteresting investigation as to the bearing powers of boilers, and the pressure at which they can be worked with safety.

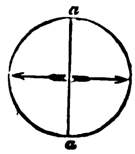
It has been stated that the strengths of cylindrical boilers, when taken in the direction of their circumference, are in the ratio of their diameters, and when taken in the direction of the ends, as the squares of the diameters—a proposition which it will not be difficult to demonstrate as applicable to every description of boiler of the cylindrical form. It will be seen, however, that the strain is not exactly the same in every direction, and that there is actually less upon the material in the longitudinal direction, than there is upon the circumference. For example, let us take two boilers, one three feet diameter and the other six feet, and suppose each to be subject to a pressure of 40 lbs. to the square inch. In this condition, it is evident that the area, or number of square inches in the end of a three-feet boiler, is to that of the area of the six-feet boiler as 1 to 4; and, by a common process of arithmetic, it will be found that the edges of the plates forming the cylindrical part of the three-feet boiler is subject (at 40 lbs. on the square inch) to a pressure of 40,712 lbs.—upwards of 18 tons; whereas the plates of the six-feet boiler have to sustain a pressure of 162,848 lbs., or 72 tons, which is quadruple the force to which the boiler only one-half the diameter is exposed; and the cir-

* See *ante* p. 94.

† By experiment, it is found that the strength of the riveted joints of boilers is only about one-half the strength of the plate itself; but taking into consideration the crossing of the joints, 34,000 lbs. may reasonably be taken as the tenacity of the riveted plates, or the bursting pressure of a cylindrical boiler.

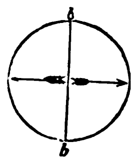
cumferences being only as two to one, there is necessarily double the strain upon the cylindrical plates of the large boiler. Now this is not the case with the other parts of the boiler, as the circumference of a cylinder increases only in the ratio of the diameter; consequently the pressure, instead of being increased in the ratio of the squares of the diameter, as shown in the ends, is only doubled, the circumference of the six-feet boiler being twice that of the three-feet boiler.

Let us, for the sake of illustration, suppose the two cylindrical boilers, such as we have described, to be divided into a series of hoops of one inch in width; and, taking one of these hoops in the three-feet boiler, we shall find it exposed at a pressure of 40 lbs. on the square inch, to a force of 1,440 lbs., acting on each side of a line drawn through the axis of a cylinder 36 inches diameter, and 1 inch in depth, and which line forms the diameter of the circle. Now this force causes a strain upon the points, *a a*, in the direction of the arrows in the annexed diagram of the three-feet circle of 720 lbs.; and assuming the pressure to be increased till the force becomes equal to the tenacity or retaining powers of the iron at *a a*, it is evident, in this state of the equilibrium of the two forces, that the least preponderance on the side of the internal pressure would insure fracture.



And suppose we take the plates of which the boiler is composed at one quarter of an inch thick, and the ultimate strength at 34,000 lbs. on the square inch, we shall have $\frac{3,400}{36 \times 2} = 472$ lbs. per square inch as the bursting pressure of the boiler.

Again, as the forces in this direction are not as the squares, but simply as the diameter, it is clear that at 40 lbs. on the square inch, we have in a hoop an inch in depth, or that portion of a cylinder whose diameter is 6 feet—exactly double the force applied to the point, *b b*, as was acting on the point, *a a*, in the diameter of 3 feet. Now, assuming the plates to be a quarter of an inch thick, as in the three-feet boiler, it follows, if the forces at the same pressure be doubled in the large cylinder, that the thickness of the plates must also be doubled, in order to sustain the same pressure with equal security; or, what is the same thing, the six-feet boiler must be worked at half the pressure, in order to insure the same degree of safety as attained in the three-feet boiler at double the pressure. From these facts it may be useful to know, that boilers having increased dimensions should also have increased strength in the ratio of their diameter; or, in other words, the plates of a six-feet boiler should be double the thickness of the plates of a three-feet boiler, and so on, in proportion as the diameter is increased.



The relative power of force applied to cylinders of different diameters become more strikingly apparent when we reduce them to their equivalents of strain per square inch, as applied to the ends and circumference of the boiler respectively. In the three-feet boiler, working at 40 lbs. pressure, we have a force equal to 720 lbs. upon an inch width of plate, and one quarter of an inch thick, or 720 by 4, equal 2,880 lbs., the force per square inch upon every point of the circumference of the boiler.

Let us now compare this with the actual strength of the riveted plates themselves, which, taken as before, at 34,000 lbs. on the square inch, we arrive at the ratio of pressure as applied to the strength of the circumference as 2,880 to 34,000, nearly as 1 to 12, or 472 per square inch, as the ultimate strength of the riveted plates.

These deductions appear to be true in every case as regards the resisting powers of cylindrical boilers, to a force radiating in every direction from its axis towards the circumference; but the same reasoning is, however, not maintained when applied to the ends, or, to speak technically, to the angle-iron and riveting, where the ends are attached to the circumference. Now, to prove this, let us take the three-feet boiler where we have 113 inches in the circumference; and upon this circular line of connection we have, at 40 lbs. to the square inch, to sustain a pressure of 18 tons, which is equal to a strain of 360 lbs. acting longitudinally upon every inch of the circumference. Apply the same force to a six-feet boiler, with a circumference or line of connection equal to 226 inches, and we shall find it exposed to exactly four times the force, or 72 tons; but in this case it must be borne in mind that the circumference is doubled, and consequently the strain, instead of being in the quadruple ratio, is only doubled, or a force equal to 720 lbs. acting longitudinally as before upon every inch of the circumference of the boiler. From these facts we come to the conclusion, that the strength of cylindrical boilers is in the ratio of their diameters, if taken in the line of curvature, and as the squares of the diameters as applied to the ends or their sectional area; and that all descriptions of cylindrical tubes, to bear the same pressure, must be increased in strength in the direction of their circumference simply as their diameters, and in the direction of the ends as the squares of the diameters.

Again, if we refer to the comparative merits of the plates composing cylindrical vessels, subjected to internal pressure, they will be found in this anomalous condition, that the strength in their longitudinal direction is twice that of the plates in the curvilinear direction. This appears by a comparison of the two forces, wherein we have shown that the ends of the three-feet boiler, at 40 lbs. internal pressure, sustain 360 lbs. of longitudinal strain upon each inch of a plate a quarter of an inch thick, whereas the same thickness of plates have to bear, in the curvilinear direction, a strain of 720 lbs. This difference of strain is a difficulty not easily overcome, and all that we can accomplish in this case will be to exercise a sound judgment in crossing the joints, the quality of the workmanship, and the distribution of the material. For the attainment of these objects, the following table, which exhibits the proportionate strength of cylindrical boilers from three to eight feet in diameter, may be useful.

TABLE of equal strength in Cylindrical Boilers from three to eight feet diameter, showing the thickness of metal in each respectively, at a pressure of 450 lbs. to the square inch:—

Diameter of Boilers. Feet.	Inches.	Bursting pressure—equivalent to the ultimate strength of the riveted joint—as deduced from experiment. 34,000 lbs. to the square inch.	Thickness of the plates in decimal parts of an inch.
3	0		.250
3	6		.291
4	0		.333
4	6		.376
5	0		.416
5	6	450 lbs.	.458
6	0		.500
6	6		.541
7	0		.583
7	6		.625
8	0		.666

Boilers of the simple form, and without internal flues, are subjected only to one species of strain; but those constructed with internal flues are exposed to the same tensile force which pervades the simple form, and further, to the force of compression, which tends to collapse or crush the material of the internal flues. In the cylindrical boiler, with round flues, the forces are diverging from the central axis as regards the outer shell, and converging, as applied to every separate flue which the boiler contains.

These two forces in a steam-boiler are in constant operation; the tendency of the one being to tear up the external plates and force out the ends, and the other to destroy the form, and to force the material into the central area of the flues. These two forces operate widely different upon the resisting powers of the boiler, which, taken in the direction of its exterior envelope, has to resist a tensile strain operating in every direction from within, and the internal flues acting as an arch, offer a powerful resistance to compression from without. It might be instructive as well as interesting to exhibit the nature of these powers, and determine the law by which vessels of this description are retained in shape; but this can only be done by experiment, and as these experiments would have to be conducted upon a large scale, and with great accuracy, in order to arrive at satisfactory results, we must abandon the idea for the present, and content ourselves with such information as we already possess. At some future period I may possibly devote my attention to this subject; it is one of great importance, and a series of well-conducted experiments would, I make no doubt, supply valuable data in the varied requirements of boiler construction, and their comparative powers of resistance to the united force of tension and compression.

From the existing state of our knowledge, we must rest satisfied with the fact, that the resisting powers of cylindrical flues to compression will be directly as their diameters, and we may therefore conclude, that a circular flue, eighteen inches diameter, will resist double the pressure of one three feet diameter. Hence it follows, that the resistance of wrought-iron plates of the circular form is to the force of compression as their diameters—the same, but with greatly diminished powers, as compared with the resistance of wrought-iron cylindrical plates to tension.

To show the amount of strain upon a high-pressure boiler, 30 feet long, 6 feet diameter, having two centre flues each, 2 feet 3 inches diameter, working at a pressure of 50 lbs. on the square inch, we have only to multiply the number of square feet of surface, 1,030, exposed to pressure, by 3.21, and we have the force of 3,319 tons, which a boiler of these dimensions has to sustain. I mention this to show that the statistics of pressure, when worked out, are not only curious in themselves, but instructive as regards a knowledge of the retaining powers of vessels so extensively used, and on which the bread of thousands depends. To pursue the subject a little further, let us suppose the pressure to be at 450 lbs. on the square inch, which a well-constructed boiler of this description will bear before it bursts, and we have the enormous force of 29,871, or nearly 30,000 tons bottled up within a cylinder 30 feet long, and 6 feet diameter.

This is, however, inconsiderable, when compared with the locomotive, and some marine boilers, which, from the number of tubes, present a much larger extent of surface to pressure. Locomotive engines are usually worked at 80 to 100 lbs. on the inch, and taking one of the usual construction, we shall find, at 100 lbs. on the inch, that it rushes forward on the rail with a pent-up force, within its interior, of nearly 60,000 tons, which is rather increased than diminished at an accelerated speed.

In a stationary boiler charged with steam at a given pressure, it is evident that the forces are in perfect equilibrium, and the strain being the same in all directions, there will be no tendency to motion. Supposing, however, this equilibrium to be destroyed, by accumulative pressure, till rupture ensues; it then follows that the forces in one direction having ceased, the others in an opposite direction, being active, would project the boiler from its seat with a force equal to that which is discharged through the orifice of rupture. The direction of motion would depend upon the position of the ruptured part; if in the line of the centre of gravity, motion would ensue in that direction; if out of that line, an oblique or rotatory motion round the centre of gravity would be the result.

The velocity or quantity of motion produced in one direction, would be equal to the intensity or quantity lost; and the velocity with which the body would move,

would be in the ratio of the impulsive force, or the quantity lost. Therefore, the quantity of motion gained by an exploded boiler in one direction, will be as its weight and the quantity lost in that direction. These definitions are, however, more in the province of the mathematician, and may easily be computed from well-known formula on the laws of motion.

We now come to the rectangular forms, or flat surfaces, which are not so well calculated to resist pressure. Of these we may instance the fire-box of the locomotive boiler, the sides and flues of marine boilers—the latter of which, by the by, are now superseded by those of the tubular form—and the flat ends of the cylindrical boilers, and others of weaker construction.

The locomotive boiler is frequently worked up to a pressure of 120 lbs. on the square inch, and at times, when rising steep gradients, I have known the steam nearly as high as 200 lbs. on the inch. In a locomotive boiler subject to such an enormous working pressure, it requires the utmost care and attention on the part of the engineer to satisfy himself that the flat surfaces of the fire-box are capable of resisting that pressure, and that every part of the boiler is so nearly balanced in its powers of resistance, as that, when one part is at the point of rupture, every other part is on the point of yielding to the same uniform force. This appears to be an important consideration in mechanical constructions of every kind, as any material applied for the security of one part of a vessel subject to uniform pressure, whilst another part is left weak, is so much material thrown away; and in stationary boilers, or in moving bodies, such as locomotive engines and steam-vessels, they are absolutely injurious, at least so far as the parts are disproportionate to each other, and the extra weight, when maintained in motion, becomes an expensive and unwieldy encumbrance. A knowledge of the strength of the materials used, judicious care, and the exercise of sound judgment in its distribution, are, therefore, some of the most essential qualifications of the practical engineer. Our limited knowledge, and defective principles of construction, are manifest from the numerous abortions which exist; and although I am free to communicate all that I know on this subject, I nevertheless find myself deficient in many of the requirements necessary for the attainment of sound principles of construction.

Reverting to the question more immediately under consideration, it is, however, essential to give the requisite security to those parts which, if left unsupported, would involve the public as well as ourselves in the greatest jeopardy.

The greater portion of the fire-boxes of locomotive boilers, as before noticed, have the rectangular form, and in order to economise heat, and give space for the furnace, it becomes necessary to have an interior and exterior shell: that which contains the furnace is generally made of copper, firmly united by rivets, and the exterior shell, which covers the fire-box, is made of iron, and united by rivets, in the same way as the copper fire-box. Now these plates would of themselves—unless supported by riveted stays—be totally inadequate to sustain the pressure. In fact, with one-tenth the strain, the copper fire-box would be forced inwards upon the furnace, and the external shell bulged outwards; and with every change of force these two flat surfaces would move backwards and forwards, like the sides of an inflated bladder, at the point of rupture. To prevent this, and give the large flat surfaces an approximate degree of strength with the other parts of the boiler, wrought-iron or copper stays, one inch thick, are introduced; they are first screwed into the iron and copper on both sides, to prevent leakage, and then firmly riveted to the interior and exterior plates. These stays are about six inches asunder, forming a series of squares, and each of them will resist a strain of about fifteen tons before it breaks.

Let us now suppose the greatest pressure contained in the boiler to be 200 lbs. on the square inch, and we have $6 \times 6 \times 200 = 7{,}200$ lbs., or $3\frac{1}{4}$ tons, the force applied to a square of 36 inches; now, as these squares are supported by four stays, each capable of sustaining 15 tons, we have $4 \times 15 = 60$ tons as the resisting powers of the stays; but the pressure is not divided amongst all the four, but each stay has to sustain that pressure, consequently the ratio of strength to the pressure will be as $4\frac{1}{2}$ to 1 nearly, which is a very fair proportion for the resisting power of that part.

We have treated of the sides; but the top of the fire-box and the ends have also to be protected, and there being no place but the circular top of the boiler from which to attach stays, it has been found more convenient and equally advantageous to secure those parts by a series of strong wrought-iron bars, from which the roof of the fire-box is suspended, and which effectually prevents it from being forced down upon the fire. It will not be necessary to go into the calculations of those parts; they are, when riveted to the dome or roof, of sufficient strength to resist a pressure of 300 to 400 lbs. on the square inch. This is, however, generally speaking, the weakest part of the boiler, with the exception, probably, of the flat ends, above the tubes in the smoke-box, where they are not carefully stayed.

In the flat ends of cylindrical boilers, and those of the marine construction, the same rule applies as regards construction; and the due proportion of the parts, as in those of the locomotive boilers, must be closely adhered to. Every description of boiler used in manufactories, and also those on board of steamers, should, in my opinion, be constructed to a bursting pressure of 400 to 500 lbs. on the square inch, and locomotive engine boilers, which are subjected to a much severer duty, to a bursting pressure of 600 to 700 lbs.

It now only remains for me to state, that internal flues, such as contain the furnaces in the interior of the boiler, should be kept as near as possible to the cylindrical form; and as wrought-iron will yield to a force tending to crush it of about one-half of what would tear it asunder, the flue should in no case exceed one-half the diameter of the boiler, and with the same thickness of plates it may be considered equally safe to the other parts. In fact, the force of compression is so different to that of tension, that I should advise the diameter of the internal flues to be in the ratio of 1 to $2\frac{1}{2}$, instead of 1 to 2, of the diameter of the boiler.

I will not trouble you with a description of the haycock, hemispherical, and waggon-shaped boilers—they are all bad as respects their powers of resistance, and ought to be entirely exploded. I shall congratulate the public when they disappear from the list of those constructions entitled to the confidence of the public, and the considerations of the man of science as well as the practical engineer.

The subject of construction is one of vast importance, and those forms which give the greatest security with the least quantity of material may be considered as the safest examples for imitation—the true elements of construction. Boilers of all other vessels require, in the variety of their conditions, shapes, and dimensions, the head of the philosopher as well as the hands of the mechanic. They contain, within comparatively narrow bounds, a force which, if properly governed, will propel the largest and most stately vessel against wind and tide; perform the work of a thousand hands, and drive a hundred cars loaded with one hundred tons, at the speed of the swiftest race-horse, from one extremity of the kingdom to the other.

MONTHLY NOTES.

The Marine Steam Force of Great Britain.—Great Britain possesses one hundred and forty-seven steam-ships, including three in Canada, and thirty-two iron steamers, eleven ranging from 1,547 to 1,980 tons. Of these, four were formerly 76-gun ships, and have now engines of 450 horse-power. The largest, the Simoom, of 1,980, has only 350 horse-power; the Terrible, however, of 1,850, has engines of 800 horse-power; the Termagant, of 1,547, has engines of 620 horse-power; while the Arrogant, of 1,872, has only 360 horse-power; the Retribution, of 1,641, has 400 horse-power. One of the above eleven, the Penelope, was a 46-gun frigate. Fifteen from above 1,200 and under 1,500 tons, twenty-seven above 1,000 and under 1,200, twenty-three above 700 and under 1,000, nine above 500 and under 700, twenty-seven from 250 and under 500, twenty-two from 150 and under 250, four from 42 to 149; three on the lakes of Canada, one of 406 and of 90 horse-power, and one of 750 and of 200 horse-power; twelve packets, 237 to 720, some of which are very fine vessels; 58,643 in commission, and 58,501 tons in ordinary. Of the steamships there are built of iron—the Simoom, 1,984; the Vulture, 1,764, both 350 horse-power; the Greenock, 1,418, and 550 horse-power; the Birkenhead, 1,405, and 556 horse-power; the Niagara, 1,395, and 350 horse-power; the Trident, 850, and 350 horse-power; the Antelope, 650, and 264 horse-power; the packet Lizard, 340, and 150 horse-power; the Bloodhound, 378, and 150 horse-power; the Grappler, 557, and 220 horse-power; the Sharpshooter, 503, and 202 horse-power; the Harpy, 344, and 200 horse-power; the Myrmidon, about 350, and 180 horse-power; the Sphynx and Fairy, about 300, and 110 horse-power; and four other smaller vessels, of 20 to 9 horse-power. Six of the packets are built of iron. Screw-steamers on the stocks, viz., one 80-gun at Devonport, one 80-gun at Woolwich, and one 80-gun at Pembroke; in all, one hundred and fifty steamships. Then there is the mercantile steam power. The steam vessels registered in the port of London on the 1st of January, 1851, was three hundred and thirty-three: one hundred and seventeen under 100 tons, sixty-four from 100 to 200, twenty-six from 200 to 250, twenty-seven from 250 to 300, sixteen from 300 to 350, nine from 350 to 400, ten from 400 to 450, eight from 450 to 500, three from 500 to 550, seven from 550 to 600, three from 600 to 650, six from 650 to 700, two from 700 to 750, five from 750 to 800, three from 850 to 900, one from 900 to 950, eight from 1,000 to 1,500, six from 1,500 to 1,800, eleven from 1,800 to 2,000, and one above 2000 tons. In Liverpool there were ninety-two steam-vessels: twenty under 100 tons, forty-nine from 100 to 200, twelve from 200 to 400, six from 400 to 600, three from 600 to 800, one of 1,300 tons, and one of 1,609 tons. At Bristol there were thirty-one steam-vessels: eleven under 100 tons, fourteen above 100 tons and under 300, three from 300 to 500, two from 500 to 600, one (Great Britain) of 2,936. At Hull there were thirty-four steam-vessels: eight under 100 tons, seven from 100 to 200 tons, eight from 200 to 400, eight from 400 to 700, two from 700 to 1,000, and one of 1,320 tons. At Shields there were fifty steam-vessels: forty-eight under 100 tons, one of 388, and one of 106 tons. At Sunderland there were thirty-two steam vessels under 100 tons. At Newcastle-upon-Tyne there were one hundred and thirty-eight steam-vessels: one hundred and thirty under 100 tons, six from 100 to 300, two from 300 to 500. At Southampton there were twenty-three steam vessels: nine under 100 tons, nine from 100 to 300, five from 300 to 500. At Glasgow there were eighty-eight steam-vessels: fourteen under 100 tons, forty-eight from 100 to 300, sixteen from 300 to 700, three from 700 to 1,000, five from 1,000 to 2,000, two from 2,000 to 2,500. At Leith there were twenty-three steam-vessels: eight under 100 tons, twelve from 100 to 500 tons, three 500 to 1,000 tons. At Aberdeen there were sixteen steam vessels: three under 100 tons, four from 100 to 300, three from 300 to 600, five from 600 to 1,000, and one of 1,117 tons. At Dublin there were forty-four steam-vessels: three under 100 tons, fifteen from 100 to 300, thirteen from 300 to 500, thirteen from 500 to 800 tons. At Dundee there were ten steam-vessels: five under 100 tons, two from 100 to 300, three from 500 to 800. At other ports there were two hundred and seventy steam-vessels: one hundred and thirty-nine under 100 tons, sixty-one above 100 and under 250, forty-five from 250 to 500, twenty-two from 500 to 750, and three from 750 to 1,000.

The late Mr. Edmondson, the inventor of the modern Railway Ticket System.—We have this month to record the death, at Manchester, of Mr. Thomas Edmondson, whose beautiful machinery for printing and numbering railway tickets must be familiar to many of our readers. He was originally a cabinet-maker, in the establishment of Messrs. Gillow & Co. of Lancaster; but in 1839 he filled the situation of station-clerk at Milford, near Carlisle, at £60 per annum. He there attracted the attention of Captain Laws (the general manager of the Lancashire and Yorkshire Railway), by a contrivance of a simple but efficient sys-

tem of checking the traffic passing Milford station, which he had voluntarily adopted for his own satisfaction, but which, on the Lancashire and Yorkshire Railway, under the old system, would have required 3,000 different pass-books at each station, and a corresponding staff of clerks. Captain Laws took him to Manchester, and his system was adopted by the Lancashire and Yorkshire Company, in whose service he rose until he became the chief of the audit department. The printed ticket, and his elaborate system of check and counter-check of accounts, have since been gradually adopted by every railway in Great Britain and Ireland.

Captain Shrapnel's Strada-Metrical Survey of London.—Capt. N. Scrope Shrapnel, the inventor of various valuable improvements in gunnery and domestic mechanism, has just issued the first part of a useful publication, embodying a "Strada-metrical Survey of London," or table of street measurements. It contains the mean distances, with their relative cab fares, from all the principal streets and places in London, to the Exhibition and the several railway stations in the metropolis. It will be an excellent pocket companion for all cab travellers, or, indeed, for all classes of persons whose avocations lead them to and fro in the metropolis. The author announces a second part, to contain 6,200,000 mean distances and fares, from any street or square to any other street or square, so that the most accurate and explicit information will thus be put before the merest tyro in London travel. If these books work well in practice—and we see no reason why they should not—we shall hope that all provincial towns of any magnitude will shortly be furnished with similar guides.

Patent Law Reform.—Hitherto the main object of almost all patent law reformers has been to reduce the cost, the trouble, and the unnecessary delays which beset an inventor in his endeavours to protect the results of his individual ingenuity or skill from becoming common property; and this is unquestionably one, if not the most pressing, branch of the coveted amendments. The main points, however, to be determined with respect to the existing law may be reduced to two:—*First*, Whether the protection now afforded by the State to the inventor is based upon sound principles; that is to say, does it, by the protection which it extends, sufficiently recompense him for what he has done, and offer inducements to him and others to continue their exertions in the wide field of improvement? and, at the same time, does it, while granting this aid and stimulus to the inventor, preserve the public from the injurious effects of monopoly? *Secondly*, Is this protection which the law proposes to grant to every one who can prefer a just claim, practically within the reach of all? To both these questions we answer in the negative, on the ground that the protection afforded is very limited, and that the cost is ruinous. The peculiar importance to architecture, of recognition of the rights of inventors, it will, we presume, not be very difficult to show. The number of inventions for the improvement of materials and building processes is very great; but many of them which promise to answer most important objects prove complete failures, from the want of proper foresight as to the effect of atmospheric influences, wear and tear, or some similar *item*, not to be exactly calculated until after the experience of many years. The result of this is, that inventions of real value too often do not receive that attention from architects which they might turn out to deserve, and the profession is accused of having *prejudices* against all improvements. The determination, however, constantly to regard the importance of influences which time alone can develope is always worthy of support, however unpleasantly it may sometimes place the professional architect, in having to resist the suggestions of an employer, made without that forethought which actual experience of many most unexpected failures alone can give. The vulgar proverb as to a burnt child, &c., might be very well applied to architects, and the extreme caution engendered would, to any one acquainted with facts, justify the apprehension which is often felt, even where the reason given might otherwise appear vague and indefinite. He who deals with brick and stone is supposed to build for years, and grieved are we to think how often any other intention is evinced in modern house building; that is, an intention which is plain to that very small number who are acquainted with the science and the practice of construction, but not so to those who buy and rent houses. Since, therefore, it is important, not only that improvements should continue to be made in materials and processes which are still inadequate to particular objects, but that inventions should start "full armed, from the brain," and resist the most searching ordeal, we regard it of the utmost value, to cultivate that inventive faculty in the *workman*, already found to so great an extent, and which has been one of the chief incitements to the agitation of the present subject. We look upon the professional architect and the artisan as natural allies. They stand somewhat in the same relative positions as the holder of an entailed estate and his grandson. Highly as we estimate theoretical principles, and their direct application, every architect knows that information of the utmost value lies scattered about in the class of building artisans, and the columns of our weekly contemporary are sufficient evidence of that fact. It is information which can be obtained, in most cases, only during actual contact with building and mechanical operations, and by manual labour. It is the best, and at the same time the only, substitute for the test of years. To ourselves, the existence of this knowledge, obtained by observation and experience, gives a high estimate of the importance of the class possessing it; it is a ground not only for *respect* for that class far higher than is awarded to it by the ignorant, but is connected with the question of the elevation of the social condition of the artisan, in a manner which makes our subject worthy of the particular attention of the benevolent individuals who are working towards that end. We would have attention directed to improvements in connection with practical architecture; we would wish inventions to be real improvements, and that we should be troubled with no others; and we would reap the full benefit of the originating spirit, or active aid, of that most valuable ally, the artisan. To insure this, we must do him simple justice. Dissatisfaction of a most prejudicial—even a dangerous—nature, cannot but exist, when a large class, full of inventive talent, find the advantages of their *own* improvements universally absorbed by those who have helped the success of the invention, merely in *one* important requisite—capital. Discoveries will continue to be held secret, in the hope of ultimate success, and die with their inventors, instead of contributing to the happiness of society; for, the expense and difficulty of a patent stands at the outset. Without this charge, a patent might more frequently fall to the lot of the real inventor, who is, one would think, the best entitled to any advantage which his invention could confer. The Society of Arts, as the recognised moving power in matters of invention, has acted well in directing its attention to the interests of that class which it has done so much to foster. We cannot pretend, within present limits, to do real justice either to the subject or to the society's labours. We are not unmindful of that constant fostering spirit, if we direct attention to some opposite results of the inventive *mania*, which we ought not wholly to disregard, and which, in the opinion of some, would be developed to a great extent by a cheap and facile system of obtaining patents. It must be admitted, that the necessity, at present, for resorting to a patent agent, is often most beneficial to the interests of the inventor. The genius for contriving is apt to be somewhat erratic, and, no doubt, many a castle half poised in air, has been placed on solid foundation by the patent agent; and for that, we doubt whether this profession has, in all cases, received full justice. To entail an addition to the number of useless patents, would add to the trouble with new inventions, of which artichects, as we have shown, have at present reason to complain, but this we think only to an inconsiderable degree. The necessity has always existed for the architect to be well assured of his mechanical appliances; it is quite beyond his power to test every invention that appears under the present system; and though, calculating *chances*, it might be less probable than any particular valuable invention should be brought to his notice, the slight difference would be more than counterbalanced by many advantages resulting from the publication of inventions which are now kept back, and the facilities for perfecting inventions, which, confessedly, would be available.—*Architectural Quarterly Review.*

Recovery of the Peterhoff Steam Yacht.—This fine vessel, built by Mr. Mare, at Blackwall, and fitted with engines by Messrs. Rennie, to serve as an Imperial yacht to the Emperor of Russia, and which went, when on her passage to St. Petersburgh, on the rocks off the Island of Oessel, in October last, has been recovered, and is now at Blackwall, apparently in as good a state as before the accident, with the exception of the wood panelling of the cabins, which has yielded to the ill-treatment it received, and long immersion under water; but the hull and engines are as good as ever. Various attempts were at first made by the captain and crew of the vessel to get her off, assisted by some officers and men sent by the Russian Government, but without success. The vessel stuck fast on the ridge of rocks with a hole in her bottom, and, being constructed of iron, she was abandoned by the Russian authorities to the agent of the company in London who had insured her, and the company sent out an able officer—Captain Fell—who after great exertions succeeded in getting her off the rocks. He let the water into every part of her, and allowed her to remain full all the winter. This bold experiment had the effect of preserving her from being battered by the winter storms, and in the spring the vessel was raised, and, after being partially repaired, he floated her to Riga, where she underwent a more thorough repair. He then tried the engines, and found that they worked well, and on trying the speed of the vessel at the measured mile, near Riga, the result was ascertained to be 16 knots an hour. From Riga Captain Fell proceeded with the vessel to Elsinore, and from Elsinore to Hamburgh, where he lay for a short time, and then left for England, and although he had to contend against a strong head wind, reached the East India Docks, at Blackwall, in 36 hours, being a distance of about 500 miles, showing the average speed of the vessel during the voyage to be at the rate of upwards of $13\frac{1}{2}$ knots per hour.

The Parana Steamship.—The West India mail steam-ship *Parana*, of 2,250 tons, has just been launched from the building-yard of Messrs. Wigram & Sons, at Northam, near Southampton. A description of this fine ship is unnecessary, inasmuch as she resembles in every respect, both in size and power, the three steam-ships *Oronoco*, *Amazon*, and *Magdalena*, recently launched in the Thames. The Royal Mail Steam Packet Company have now four out of five of their new steam fleet in the water. The last ship, the *Demerara*, building at Bristol, will shortly be sent off the stocks. The *Parana* will be coppered in the Southampton Graving Docks, and is to be afterwards towed round to Greenock to receive her engines and boilers, which are being constructed by Messrs. Caird & Co.

The Pleasures of Twenty Acres of Grass sheltered from all Weathers.—The Crystal Palace has shown us how a space large enough for a city may be covered in, and how walks might be enjoyed, not between dark walls and under roofs, by which the light of heaven is excluded, but where we have all the charms of out-of-doors without its drawbacks. Twenty acres of grass-plat under cover is a novel and substantial advantage; and though you should clear this transparent cover away from Hyde Park, it is not too much to predict, that the example of it set and rejected by London will be followed throughout the country by every large town which has a keener sense of its obvious and practical utility. There is hardly any promenade or rendezvous in London like that afforded by the Prado at Madrid, or the public walks in Vienna and Dresden, because the climate forbids them. But the Crystal Palace will make us independent of climate, and English people may have a source of enjoyment from it that has not been hitherto revealed to them. Merely as a covering to a grass plat giving a public rendezvous, which would afford a solace to the old and sick, and a useful, purpose-like gratification to the young, the Crystal Palace has claims to be preserved. But we may go farther and find a wider use for the space. Let us imagine the glass house made a garden, and warmed with a summer temperature all the winter. It would seem to be a public want as soon as the idea presents itself. When a man has a house and grounds, one of his first thoughts is to secure the beauty and pleasure of vegetation

all the year round. It would be strange that London should never have provided itself with a conservatory or winter garden, if we did not see that the excise-duty on glass had been the preventive. Having now got a structure through the Exhibition, we find that the same structure may have a second and scarcely less valuable use. We may conceive the building properly supplied with fountains and sculpture, arranged between groves of orange-trees, and pathways laid between plantations more or less characteristic of the vegetation of different climates—being, in fact, a most enjoyable and instructive promenade. With the co-operation of the Agricultural, Horticultural, and Botanical Societies, various popular schools, lectures, and exhibitions connected with the objects of these societies, would arise naturally out of such an arrangement, and might be made to have a most important bearing both on the productive resources of the country, and on our decorative manufactures.—*Denarius.*

The After use of the Exhibition Building.—Lord Brougham, in his character as an advocate for the retention of the building, and Lord Campbell as counsel on the opposite side, have lately afforded the upper house some amusement, by venturing a little into their old game of senatorial sparring. A very short time will decide the fate of our wonderful structure. Let us hope that the point will be dispassionately argued; and that the authorities may consider it with unprejudiced minds. We are well satisfied that a calm examination will bring them to a pretty close agreement with the spirit of Mr. Paxton's petition for its use as a winter garden. In his words, the advantages derivable from such an appropriation of the Crystal Palace would be many, and may be thus briefly summed up:—1. In a sanitary point of view its benefits would be incalculable. 2. By its various objects it would produce a new and soothing pleasure to the mind. 3. The great truths of nature and art would be constantly exemplified. 4. Peculiar facilities would especially be given for the development, on a large scale, of the sciences of botany, geology, and ornithology. 5. A temperate climate would be supplied at all seasons. 6. Taste would be improved, by individuals becoming familiar with objects of the highest order of art, and by viewing the more beautiful parts of nature without its deformities. 7. Pleasant exercise could be taken at all times, and in every variety of weather. 8. It would serve as a promenade or lounge, and as a place which could at all seasons be resorted to with advantage by the most delicate.

Artificial Climates in the Crystal Palace.—Within the last twenty years, the physiology, economy, and requirements of animated nature, with the effects which climate, locality, and various contingencies have upon their health and habits, have been studied and examined, with the best results. Geology, closely connected with the study of plants, has, in its wondrous discoveries, unfolded to our view the mysteries of ages long gone by, when the earth's inhabitants differed widely from those now seen occupying its surface; of these no recorded history furnishes us with particulars, and but for this science we must have looked back through the thick mist of time, with scarcely a glimmering of light to guide us. By the aid of chemistry and botany many useful discoveries have been made, which practical horticulture has rendered subservient to the comforts and happiness of man; and the removal of the duty on glass has given an impetus to this science which only a short time ago no efforts could possibly have called into action; indeed, had that duty still existed, no building such as I am now treating of could possibly have been erected, and without an extensive use of glass, to equally admit and diffuse a subdued light, no such display as at present could have been secured. The achievements of horticulture, however, do not stop here, or merely consist in what has been accomplished within the Great Exhibition building, where dry and polished articles, and the most tender fabrics may be safely preserved; but it leads onwards to the formation of climates, which even under opposite influences are rendered healthy, and suited to the wants and requirements of man. Formerly, wherever plants were congregated beneath a glass structure, the atmosphere was invariably deteriorated, and rendered unfit for being more than transiently inhaled; the usual method with visitors being to take a hurried view of the chief beauties within, and then retire to a more genial air. But now plant-structures are no longer unhealthy, pent-up ovens; although the immense variety of objects they contain form a remarkable contrast with the meagre appearance of former collections, yet these objects are seen growing with an ease and natural vigour which, with the limited knowledge and means we possessed formerly, it was impossible to imitate. The ventilation and climate of our dwelling-houses have also been considered, and many additions to our comfort have in this respect been made. The perfection of these internal arrangements, contrasted with the atmosphere without, renders it still more desirable that something on a large scale should be done to counteract the effects of the outer air, which, in this country, and in the neighbourhood of London especially, is often during many months in the year impure, murky, and unfit for healthy recreation and enjoyment; and it is to meet this want that I offer the present recommendation. All hitherto erected structures, however great and noble some of them are, fall far short of answering this end, and I cannot but recommend now that we do possess a building like the Crystal Palace, which in its dimensions is the best adapted for such a purpose of anything that has been hitherto attempted, that it should be so appropriated—and especially as its peculiar site between Hyde Park and Kensington Gardens is the best spot that could have been selected; connecting as it does those two great promenades—it appears exactly calculated to concentrate beneath its roof the pleasures of both.—*Paxton.*

Steam Current for Separating and Refining Metals.—Every one knows that mercury possesses the property of uniting, so as to form an amalgam with the precious metals, and that this property has been long used in separating gold and silver from the matters with which they are found mixed. The mode of doing this embraced two processes: first, bringing about the union of the precious metal with mercury; and next, submitting the amalgam to such a heat that the mercury was driven off, leaving the gold or silver behind. The latter process is not only expensive, but injurious to the health of those engaged in it. In America, and in some European establishments, between thirteen and fifteen millions of pounds of mercury are consumed in the production of about two-and-a-half millions of pounds of gold and silver. It is said that two-thirds of the annual product of all the known mines of mercury are thus got rid of. The ashes of the gold smitheries in Paris contain nearly 2,200 lbs. of the precious metals. In treating these ashes with mercury, about the same quantity of that metal is lost. Out of a hundred workmen employed in businesses in which mercury is employed, it is calculated that ten annually lose their lives in consequence of the deleterious effects of the vapour of that metal. To remedy this double loss—of human life and valuable metal—it has lately been proposed to substitute a current of steam, raised to a high temperature, for the open fire which has hitherto been made use of. It has been found that, whilst a temperature of 5 to 600° cent. is required to drive off the mercury from the amalgam when the distillation is conducted in an open fire and a closed retort, a temperature of 350° cent. is only required when a current of steam is employed. This current of steam can be used for the double purpose of heating the amalgam, and of conveying the mercurial vapour into another vessel, where they are condensed, and the metal is thus saved. This invention is due to M. Violette, a Frenchman.

White Paint.—The deleterious effects of white lead (carbonate of lead), both in the manufacture and in use, are well known. It has lately been attempted to introduce a preparation of zinc, we believe an oxide, in place of white lead, but such is the force of habit and prejudice, that the new paint is as yet little used. Two manufactories of white zinc have been opened in the neighbourhood of Paris, but, even amongst a people fond of change, the substitution of the new for the old paint has been found as difficult as with ourselves. An able memoir, however, has been drawn up by M. Bouchut, and presented to the Academy of Medicine, giving the result of his researches. The origin and processes of the manufacture of white zinc are detailed, and the proper modes of treating it, so as to form an easily manageable paint, are described. It seems that the manufacture is attended with some peculiar effects on the persons engaged, but they are of a transitory character, and, in themselves, of slight importance. It is to be hoped that the good sense of the community will lead to the abandonment of the poisonous, and to the use of the innocuous paint.

A New Point in Vegetable Physiology.—"We cannot suppose," says Liebig in his *Chemistry in its application to Agriculture and Physiology*, "that a plant could attain maturity, even in the richest vegetable mould, without the presence of matter containing nitrogen; since we know that nitrogen exists in every part of the vegetable structure. . . . We have not the slightest reason for believing that the nitrogen of the atmosphere takes part in the process of assimilation of plants and animals." He then proceeds to state that ammonia exists in the atmosphere as a product of the decay and putrefaction of animal and vegetable matter, and that plants obtain their nitrogen from this ammonia, which is conveyed to them by rain water. No conclusion, he adds, can have a better foundation than this. From the experiments, however, of M. Ville, a French chemist, it has become a matter of doubt whether this conclusion is correct. In 20,000 litres (about 35,215 pints) of atmospheric air, he found no more than 1½ milligrammes (about ·0213 of a grain troy) of ammonia, a quantity quite insufficient to supply plants with the nitrogen they require. He then sowed the seeds of some annual plants (beans, maize, and colza) in a sterile soil, composed of white sand and pounded brick, from which all ammoniacal salt was excluded, and covering them with a bell glass; the apparatus was arranged in such a way, that the air passed under the glass was examined when it came out. The seeds germinated, and the plants prospered; but it was found that the air contained on its egress the same quantity of ammonia that it did before it entered. These experiments would seem to prove that the nitrogen they assimilated was obtained neither from the soil, nor from the ammonia of the atmosphere, but that the nitrogen of atmospheric air (into which that gas enters to the extent of 79 per cent.) was itself assimilated.

Publishing in France.—In the course of 1850 there were published, in France, 7,208 books and pamphlets; of which 4,711 were printed at Paris, 2,460 in the Departments, and 37 in Algeria. Of these publications, 1,360 were reprints or new editions, and 5,848 may be considered as new works. 6,661 were in French, 68 in provincial dialects, 53 in German, 61 in English, 2 in Arabic, 51 in Spanish, 83 in Greek, 9 in Hebrew, 16 in Italian, 165 in Latin, 14 in Polish, 16 in Portuguese, 4 in Romaic, 1 in Russian, 2 in Turkish, and 2 Polyglots. In the 7,208 works are included 73 publications printed in lithography, and 281 journals, part of them new, 79 of which appeared in the Departments. In addition to these, 2,697 engravings and lithographies appeared during the year, 122 geographical charts and plans, 579 pieces of vocal music, and 625 pieces of instrumental music.

American Marine Engineering.—A late number of the *New York Courier and Enquirer* contains a statement of the work then in progress in the New York foundries. The Allaine Works, employing from 600 to 700 men, had on hand the engines of the *Baltic*, of the Collins' line, which are amongst the largest marine engines (side lever) in the world. Two oscillating engines for a steam vessel of 2,200 tons, the largest engines hitherto constructed in America on that plan; two side-lever engines, of 65 inches diameter of cylinder, and 7 feet stroke, for another steam vessel; with many smaller engines for river boats, and a steam-press, were likewise on hand. The Archimedes Works, employing 300 men, a large engine for the steam-ship *Pacific*, five first-class sugar mills and engines, several steam boilers, and wrought-iron gates, were in preparation. The Chelsea Iron Works, employing 300 men, were constructing two iron river steam-boats, a small iron vessel, water doors, &c. At the Fulton Foundry Works, employing 250 men, upwards of a dozen boilers, and nine or ten engines and boilers for California steamers and sugar mills, were being made. At the Morgan Iron Works, 600

men employed, had on hand two pairs of large marine engines, five single engines of about 50 inches diameter of cylinder, and 10 feet stroke; five smaller engines for sugar mills, ferry boats, &c. The Novelty Works are the largest in New York, employing 1200 men. Here were being made the engines of the *Arctic*, 3,000 tons (Collins' line); of the *Franklin*, 2,300 tons, for Havre and New York; of the *Florida*, 1,300 tons; and of the *Alabama*, 1,300 tons, for each one side lever engine; also two oscillating engines for the *Golden Gate*, of 1,800 tons; one side lever engine for the *Berry*, of 1,000 tons; two side lever engines for the *Columbia*, 800 tons. The works at two other establishments are not detailed.

ENGLISH PATENTS.

Sealed from 21st June, to 17th July, 1851.

Richard Fletcher, Blackdowns Farm, parish of Ebrington, Gloucester, farmer,—" Improvements in obtaining motive power."—June 21st.

John Holmes, Birmingham, machinist,—" Improvements in machinery for cutting and stamping metals."—24th.

John Brazil, Manchester, gentleman,—" Certain improvements in dyeing, and in the preparation of dye-woods."—24th.

Richard Edward Hodges, Southampton-row, Middlesex, gentleman; and William Brockedon, Devonshire-street, same county, gentleman,—" Improvements in surgical instruments."—24th.

Alexander Parkes, Birmingham,—" Improvements in separating silver from other metals."—24th.

George Jordan Firmin, Lambeth-street, Goodman's-fields, Middlesex, manufacturing chemist,—" Improvements in the manufacture of oxalate of potass."—24th.

John Platt, Oldham, Lancashire, engineer, and Richard Burch, Haywood, Lancashire, manager,—" Certain improvements in looms for weaving."—July 3d.

James Howard, Britannia Iron-Works, Bedford, agricultural implement-maker,—" Improvements in ploughs, and other implements or machines used in the cultivation of the soil."—3d.

John Aston, Birmingham, manufacturer,—" Improvements in buttons and ornaments for dress, and the machinery for making the same respectively."—(Communication.)—3d.

Charles Payne, Wandsworth-road, Surrey, gentleman,—" Improvements in drying animal and vegetable substances, and in heating and cooling liquids."—3d.

Robert Haynes Easum, Commercial-road, Stepney, Middlesex, ropemaker,—" Improvements in the manufacture of rope."—3d.

William Hamer, Manchester,—" Certain improvements in looms for weaving."—3d.

George Kemp, Carnarvon, North Wales, doctor of medicine,—" A new method of obtaining power by means of electro-magnetism."—3d.

Richard Jex Crickmer, and Frederick William Crickmer, Page's-walk, Bermondsey, engineers and copartners,—" Improvements in packing stuffing-boxes and pistons."—3d.

Charles Cowper, Southampton-buildings, Chancery-lane, Middlesex, patent agent,—" Improvements in the preparation of cotton for dyeing and bleaching."—3d.

Charles Barlow, Esq., Chancery-lane, London,—" Improvements in rotary engines."—(Communication.)—3d.

Frederick Rosenborg, of the Albany, Middlesex, Esq.,—" Improvements in the manufacture of casks, barrels, and other like articles, and the machinery employed therein."—5th.

Henry Craven Baildon, Edinburgh, chemist,—" Improvements in writing, printing, or marking letters, characters, or figures, upon paper, parchment, or other materials properly prepared for that purpose."—7th.

James Buchanan Mirilees, Glasgow, Lanark, North Britain, engineer,—" Certain improvements in machinery, apparatus, or means for the manufacture or production of sugar."—7th.

John Hick, Bolton-le-Moore, Lancashire, engineer,—" Certain improvements in steam boilers or generators."—17th.

William Dickinson, Blackburn, Lancashire, machine-maker, and Robert Willan, of the same place, mechanic,—" Certain improvements in machinery or apparatus for manufacturing textile fabrics."—17th.

Thomas Wilks Lord, Leeds, Yorkshire, flax and tow machine-maker, and George Wilson, director of the flax-works of John Fergus, Esq., M.P., Prinlaws, Fifeshire, North Britain,—" For a machine to open and clean tow, and tow waste from flax and hemp and other similar fibrous substances, and an improved mode of piecing straps and belts for driving machinery, and a machine for effecting the same."—(Communication.)—17th.

John M'Nab, Midtownfield, Renfrewshire, North Britain,—" Certain improvements in stretching and drying textile fabrics or materials, and in the machinery or apparatus employed therein."—17th.

Arthur Albright, Birmingham, manufacturing chemist,—" Improvements in the manufacture of phosphorus, and in the apparatus to be used therein."—(Communication.)—17th.

Thomas Sanders Bale, Cauldon-place, Stafford, china manufacturer,—" Certain improvements in the method of treating, ornamenting, and preserving buildings and edifices, which said improvements are also applicable to other similar purposes."—17th.

SCOTCH PATENTS.

Sealed from 22d June, to 22d July, 1851.

John Swindells, Manchester, Lancashire, manufacturing chemist,—" Certain improvements in obtaining products from ores and other matters containing metals, and in the preparation and application of such products for the purposes of bleaching, printing, dyeing, and colour making."—25th June.

John Emmanuel Lightfoot, Broad Oak, Accrington, Lancashire, calico-printer, and James Higgin, Cobourg-terrace, Stratford-road, Manchester, same county, chemist,—" Improvements in treating and preparing certain colouring matters to be used in dyeing and printing."—26th.

Robert Hayes Easum, Commercial-road, Stepney, Middlesex, rope-maker,—" Improvements in the manufacture of rope."—1st July.

George Frederick Muntz, the younger, Birmingham, Warwick, gentleman,—" Improvements in furnaces applicable to the melting of metals for making brass, yellow metal, and other compound metals."—2d.

Thomas Allan, Edinburgh, gentleman,—" Certain improvements in electric telegraphs, and in apparatus connected therewith."—2d.

Thomas Hawkins, Inverness-terrace, Bishop's-road, Bayswater, Middlesex, oilman,—" Improvements in brushes."—16th.

John Brazil, Manchester, Lancashire, gentleman,—" Certain improvements in dyeing, and in the preparation of dye woods."—21st.

John Platt, Oldham, Lancashire, engineer, and Richard Burch, Haywood, same county, manager,—" Certain improvements in looms for weaving."—21st.

Percival Moses Parsons, Robert-street, Adelphi, Middlesex, civil engineer,—" Improvements in cranes capable of being used on railways, and in parts of railways."—21st.

IRISH PATENTS.

Sealed from 21st June, to 19th July, 1851.

Thomas Marsden, Salford,—" Improvements in machinery for hackling and combing flax, and other fibrous materials."—2d July.

William Melville, Roebank Works, Lochwinnoch, Renfrew, North Britain, calico printer,—" Certain improvements in manufacturing and printing carpets and other fabrics."—10th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 15th June, to 17th July, 1851.

June 18th,	2849.	Laurie and Marner, Oxford-street,—" Perchless carriage."
20th,	2850.	John Kerslake, Birmingham,—" Boot."
—	2851.	J. Kimberley, Birmingham,—" Door-spring."
—	2852.	Benj. Hyam, Manchester,—" Safety-pocket."
—	2853.	G. and H. Levi, Liverpool,—" Hat cigar-holder."
21st,	2854.	W. Alcock and W. C. Kilpin, Friday-street,—" Four-fold portmanteau."
23d,	2855.	I. C. Forster, Newcastle-street, Strand,—" Hat."
—	2856.	William Price, Chancery-lane,—" Spring suspender for barristers' and clergymen's gowns."
24th,	2857.	James Fry, Sunbury Mills,—" Furrows for millstone-face."
—	2858.	John Dyball, Deptford,—" Carriage-springs."
—	2859.	William Butcher, St. James's-place, Bermondsey,—" Self-acting chimney guard."
25th,	2860.	George Myers, Belvedere-road, Lambeth,—" Window-sashes."
26th,	2861.	Henry Squire, Willenhall,—" Lock."
—	2862.	D. Hulet, Holburn,—" Apparatus for working valves of dry gas meters.
—	2863.	W. Higginbottom, Manchester,—" Stand pipe and valve."
27th,	2864.	John Hall & Son, Lombard-street,—" Powder canister."
—	2865.	George Thomson, Stirling,—" Apparatus to keep a carriage body in equilibrium under different circumstances of use."
28th,	2866.	Longin Gantert, Glasgow,—" Machine for tramping and squeezing yarn and cloth by the dyeing and bleaching process."
—	2867.	A. Marion, Regent-street,—" Index or book-marker."
30th,	2868.	Will Bishop, Boston, and Robert Cooke, Huntingdon,—" Elastic tightener for trousers."
—	2869.	Edward M'Keon, Thomas MacAnaspie, and N. D. Maillard, Dublin,—" Spinning-wheel."
—	2870.	Timothy Lonasgan, Ludlow,—" Spring-lock staple."
—	2871.	G. Spill, London and Bristol,—" Thorough metallic ventilated coat."
July 3d,	2872.	George Orpwood, Bishopsgate-street,—" Register or book-mark."
—	2873.	George Mallock, Carpenter-street, Berkeley-square,—" Suspending hook."
4th,	2874.	James Kimberley, Birmingham,—" Stay and fastener for windows, doors, and shutters."
—	2875.	Nicholas Stead & Son, Hulme, Manchester,—" Ventilating chimney-top."
—	2876.	Bathgate & Wilson, Canning Foundry, Liverpool,—" Metallic cask."
—	2877.	John Pannell, Fetter-lane,—" The retort calorifere for conservatories, green-houses, &c."
5th,	2878.	Thomas Foxall Griffiths, Birmingham,—" Portable cooking-stove."
—	2879.	George Chambers & Co., Priory Mills, Studley, and Gresham-street,—" Needle eye."
7th,	2880.	Samuel Last, New Bond-street and Oxford-street,—" Prend-tout, or railway portmanteau."
8th,	2881.	Simcox & Pemberton, Birmingham,—" Blind-roller, and swing-glass axle."
9th,	2882.	Robert Smith Bartlett, Redditch,—" Part of a watch key."
10th,	2883.	W. Pearson, Maryport,—" Cooking apparatus or caboose."
—	2884.	J. Walker, City-road,—" Double-acting screw press."
12th,	2885.	P. Nicholas, Thann, France,—" Machine for engraving rollers."
15th,	2886.	J. Hall and Son, Lombard-street,—" Safety stopper and measure for powder canisters and flasks."
16th,	2887.	A. Saxon, Middleton, Lancashire,—" Throstle bobbin [246 provisional]."
—	2888.	E. Leach and Sons, Rochdale,—" Adjustable traverse slot."
—	2889.	W. Mabon, Manchester,—" Double angle iron for the cup and dip of gas-holders."
—	2890.	J. Strutt, Belper, Derbyshire,—" A cheese-turning machine."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 19th June, to 8th July, 1851.

June 19th,	252.	William Thomson, King's College,—" For working of hair."
—	253.	J. P. Oates, Lichfield,—" Perfect equitone valve for brass musical instruments."
20th,	254.	J. P. Oates, Lichfield,—" Short-action valve for cornets."
25th,	255.	Ebenezer Poulson, Sunderland,—" Reverse levers for shipping."
July 7th,	256.	Harrild & Sons, Gt. Distaff-lane,—" Printer's mitring guard."
8th,	257.	George Pigall, St. Martin's-court, Leicester-square,—" Watch guard."
—	258.	Richard Timmins & Sons, Pershore-street, Birmingham,—" Loose heater, or Italian-iron curling tongs."

TO READERS AND CORRESPONDENTS.

RECEIVED.—" Wales' Tables for Architects, Engineers, Surveyors, Builders, &c." "Reid on the Steam-Engine," third vol. " Account of the Holophotal System of Illuminating Lighthouses." " Shall we keep the Crystal Palace?" By Denarius. " What is to become of the Crystal Palace?" By Joseph Paxton.

J. M., Grantham.—See a notice to J. G. O., Sheffield, p. 216, vol. iii., of this *Journal*.—We should have much pleasure in assisting him in anything reasonable; but questions of this nature would cause too serious a draft upon our professional time.

W. H., Liverpool.—We cannot inform him at this distant date, without an extended search. His bookseller ought to be able to tell him, as it is his province to do so. Write to Mr. Hebert, 88 Cheapside, London.

APPLICATIONS OF GWYNNE'S CENTRIFUGAL PUMP.

Fig. 1.

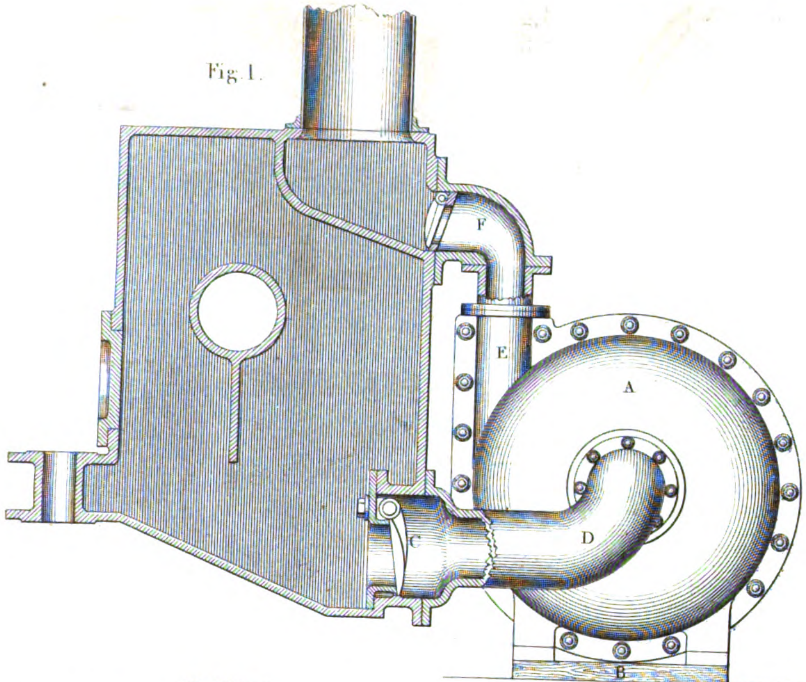


Fig. 3.

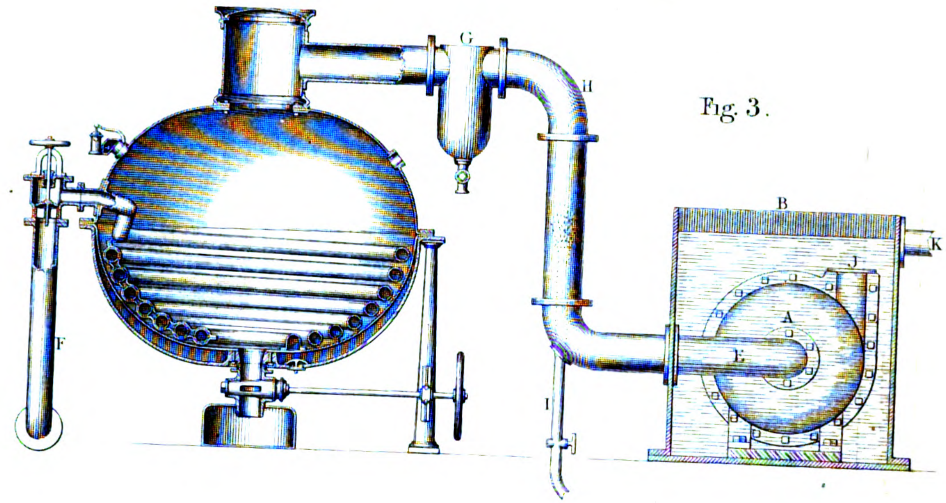


Fig. 2.

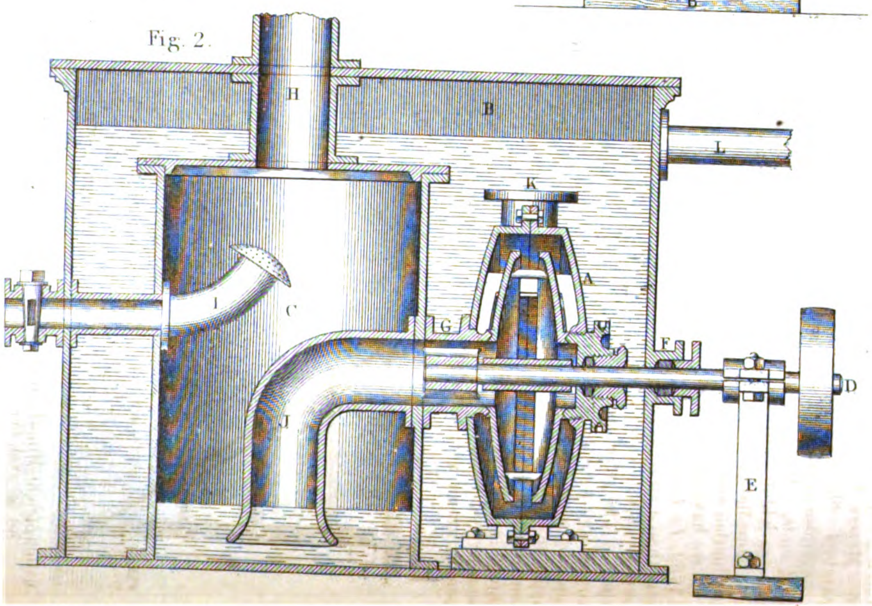
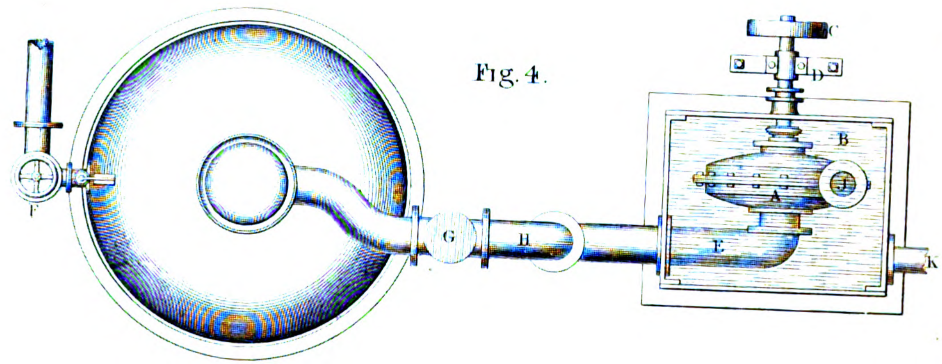


Fig. 4.



W. Johnson, Patent Offices, London, Glasgow & Edinburgh.

G. Gladwin, sculp.

THE CENTRIFUGAL PUMP.

A Historical Review.

(Illustrated by Plate 77, and 22 Wood Engravings.)

[An animated and exciting controversy, in which both commissioners, jurors, and the public took part, was maintained during the period devoted to the official examination of the mechanical department of the Great Exhibition, respecting the scientific merit, and the commercial value, of the English hydraulic engines of Mr. Appold and Mr. Bessemer, as compared with the American centrifugal pump of Mr. Gwynne. The discussion originated in an untrue statement made by the *Times* newspaper of 15th April, 1851, in which it was sought to deprive Mr. Gwynne of his undoubted rights as the improver of the centrifugal pump, but which insinuation, the editor of that paper found it necessary, afterwards, publicly to withdraw. It was soon ascertained, however, that the disavowal had failed in putting a stop to the continued circulation of similarly injurious statements. Perhaps the appended "history" may now throw a little more light on the matter.]

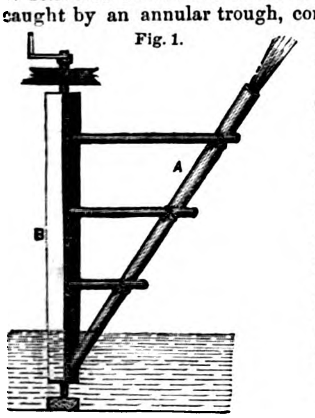
The peculiar force arising from the revolution of matter round a fixed centre, for ages distinguished for its action by the term *centrifugal*, holds a deservedly conspicuous position in the chronicles of dynamics. Commencing in the action of the earth itself, and known to the earliest of its inhabitants, it has nevertheless lain dormant, and all but useless, for the thousands of intervening years. Not until something like a century ago did it begin to assume any standing as a mechanical element, and it has been left for our own times to develop and apply it as an economically useful industrial agent. As a pump or water-elevator, we hear of it first in 1732; this, probably its earliest practical application, being by M. Le Demour, who read an account of his plan before the *French Academy*.

Since then, but not until a few years back, it has passed through an extensive series of occupations, with a rapidity as remarkable as its extreme sluggishness in earlier times. Watt's pendulum-governor—Seyrig and Manlove and Alliott's drying machines, the Tachometer, or speed-indicator, where the depression of a fluid in the centre of an upright revolving cup acts upon a fluid column, and points to the rate of revolution—Messrs. Hardman, Finzell, Rotch, Bessemer, and Gwynne's sugar-separators—Shanks' pipe-moulder—and several varieties of pumps, are all examples of what we may term the taming down of the principle to useful ends. Were it our purpose, we could easily extend the list of processes which centrifugal power has improved and extended; but our more immediate object is the tracing out the various gradations of its introduction and employment as a pump.

As we have already said, we must first turn to—

1732, *Le Demour.*—Fig. 1 is an elevation of the pump. It is nothing more than a straight tube, A, connected in an inclined position with the vertical axis, B, carried in top and bottom bearings, and turned by a winch. The attachment of the tube is rudely made by three horizontal bars of iron projecting from the shaft, B, and bound to the tube at their opposite ends by ropes. The tube is slightly expanded towards its upper end, and as it is carried rapidly round the centre of the shaft, the centrifugal force impels the water up the open lower end of the tube, throwing it out at the top in a continuous stream. Of course the fluid so delivered must have fallen in a circular stream, which was probably caught by an annular trough, corresponding to the radius of the discharging tube; but on this head we are not clearly informed.

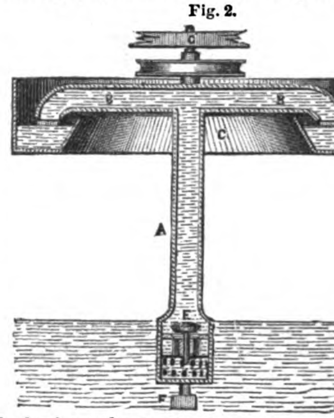
Fig. 1.



Considerable rapidity of motion is obviously necessary for the effectual performance of this kind of pump. Its action, as the nucleus of all subsequent modifications of centrifugal pumps, may be described as the throwing off the upper portion of the water-column in the rotatory discharging pipe by the direct centrifugal force, whilst the atmospheric pressure being thus relieved from the upper end, the external atmosphere presses up a further fluid supply from the source below, into which the pipe dips.

(Date unknown.) *Inverted Barker's Mill.*—Fig. 2 represents an early modification of centrifugal pumps; it appears to be simply a Barker's mill reversed. A, Is the main body of the pump, having a pair of arms, B B, projecting on each side at its upper end, after the form of the letter T. The extremities of these arms are curved downwards, in order that the liquid raised may be thrown into the circular trough, C, whence it flows off by the channel, D. The lower extremity of the vertical column, A, is made rather wider, and is perforated round its circumference by a series of holes. E, Is an ordinary foot-valve, for the purpose of retaining the liquid in the column after it has ceased working. The whole apparatus works on a footstep bearing, F, and vertical support, G. A rotatory motion may be communicated by a grooved pulley, keyed on a portion of the spindle projecting above the horizontal arms, B B.

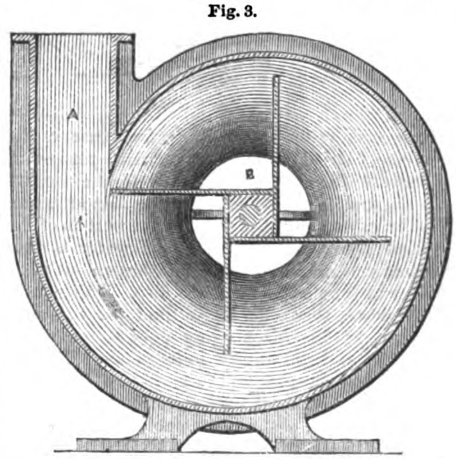
Fig. 2.



These pumps were occasionally made with a single arm, like an inverted letter L, whilst others had a series of radiating arms or dischargers. The same idea has also been carried out under the form of a series of tubes, arranged round a vertical shaft as an inverted cone.

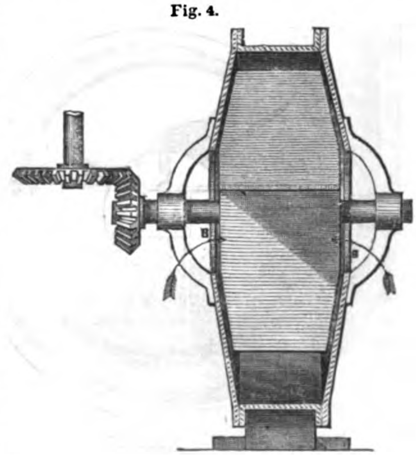
1816, *Jorge.*—In 1816, M. Jorge submitted an improvement on this plan to the *French Academy*. He conceived the idea of giving motion to the arms only, so as to save the power lost in driving the upright tube, and allowing of the latter being inclined to any angle, as circumstances might require, without interfering in any way with the action of the pump.

Fig. 3.



—— *West.*—The combination of the centrifugal pump with Barker's mill has also been proposed by Dr. West, as likely to be useful in some situations. Two separate tubes are wound round a vertical shaft, the upper one being the pump, and the lower one the actuating Barker's mill. The shaft carries a small cup-reservoir at the level of the head of the lower pipe, the bottom end of which is bent outwards at right angles, to answer as the reaction arm. The water for giving motion to the pump is supplied to this cup, and, flowing down the pipe, turns the whole apparatus, whilst the upper pipe, having a bent arm at the top, raises water from the same cup to an annular trough above.

Fig. 4.



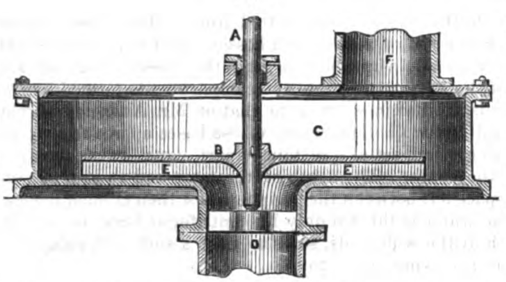
1818, *Massachusett's Pump.*—A subsequent inventor, whose name is now forgotten, introduced a species of centrifugal fan pump, in the state of Massachusetts, U. S., and which we have distinguished as the *Massachusett's Pump*. Our engraving, fig. 3, represents a vertical section of

this pump in the plane of motion of the elevating blades; and fig. 4 is a vertical transverse section of the same. This form of pump very closely resembles the ordinary blowing fan of the present day, being simply a short horizontal shaft, carrying a square boss with four eccentric blades, set eccentrically within a metal case, having an upright discharging passage, A. The whole apparatus is sunk beneath the level of the water to be lifted, and the blades being made to revolve by the pair of external bevel wheels, the water is taken in at the central aperture, B, of the case, and being impelled forwards by the revolving blades, is finally discharged by the centrifugal force through the passage, A. Fig. 4 shows that the blades are tapered towards their outer extremities or tips. This feature, together with the fact of the entry of the fluid at the central aperture of the case, and its discharge at the periphery, through a tangential pipe, must be carefully borne in mind, as we shall hereafter have particular occasion to refer to these points of detail.

1830, *Massachusetts Improved.*—The same principle of pump made its appearance in 1830, in New York, with several improvements, and exhibiting a satisfactory performance.

1831, *Blake.*—Apparently the next improvement was that by Messrs. Blake of the *New Steam Mills, Connecticut, U. S.* Fig. 5 is a vertical section of this pump, which is remarkable as being the earliest known example of centrifugal *disc* pump. Here the vertical driving shaft, A, has keyed upon it the single horizontal disc, B, working inside, and at a short distance above the bottom of the fixed case, C. The shaft is supported in a footstep, carried in the pipe, D, which opens out from a central hole in the bottom of the case, and extends to the reservoir of water to be lifted. To the under side of the revolving disc are attached a series of radiating blades, E, working just clear of the bottom of the case. As the shaft and bladed disc rapidly revolve, the water is drawn into the case by the bottom central aperture, and is thrown out from the spaces between the blades at the periphery of the disc. This continued action of the centrifugal power then effecting a fluid pressure in the case, forces a column of water up the discharging pipe, F, opening into the top of the fixed case, and at right angles to its plane. This arrangement of discharge pipe at right angles to the motion of the fluid in the pump, mars, to a great extent, this otherwise simple and effective apparatus, as it necessarily causes a most objectionable change of the direction of the fluid's motion.

Fig. 5.



1839, *Andrews.*—The continued additions to the general fund of information on the employment of centrifugal force for pumping purposes, led to the first patent for mechanism of the kind in 1839, in the *United States.* This invention was improved by Mr. W. D. Andrews, whose invention was publicly employed in the harbour of *New York* in 1844-5. Fig. 6 is a side elevation of this pump, partly in section, in the plane of motion of the blades; and fig. 7 is a transverse vertical section, showing the peculiar section of the blades and fixed case. In all points, except the form of section of the periphery of the case, this pump closely resembles the *Massachusetts* form. The water, as in it, is here taken in at the centre of the case, and expelled by the centrifugal force through the tangential discharge pipe, A. Commencing with a considerable breadth at the centre, the blades taper off quickly nearly to a point, terminating a little short of the circumferential line of the straight portions of the sides of the case, with which the shaft and blades are placed concentrically. Outside this circle, each side of the case is recessed, or made semi-tubular, so that, when combined, they form an elliptic section, gradually expanding in size from the point, B, to the full area of the discharge passage, A, thus giving the entire case considerable eccentricity in relation to the axial line of the blades. As each blade passes forward its supply of water from the centre of the case, the portions of fluid are successively thrown through the narrow annular aperture formed by the converging of the straight portions of the sides into the expanded elliptical channel, C.

Fig. 6.

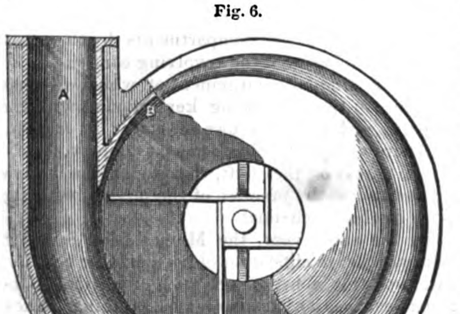
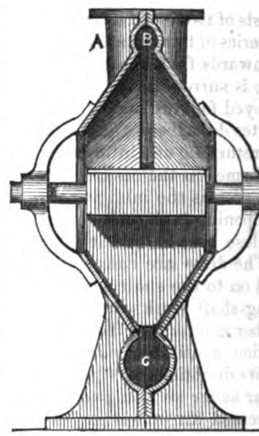


Fig. 7.



From the foregoing statement, it appears that no real improvement was made in the centrifugal pump. The disc on one side of Blake's pump was an improvement in one respect, but the alteration of the direction of discharge was so great an error as to more than counterbalance the advantages of the disc. Mr. Bessemer has fallen into the same error in his patents of 1849.

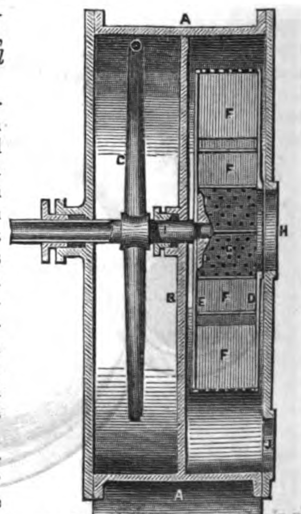
1841, *Whitelaw.*—At the latter end of 1841, Mr. James Whitelaw of Johnstone published sketches of two forms of pumps, showing the relative effect of straight and curved arms, working on what we may term the inverted *Barker's mill* principle. He also furnished some calculations as to the duty of such pumps, expressing a favourable opinion on their merits.

We now come to the improvements which are at present exciting much controversy in the Exhibition, and have led to a challenge by "the proprietors of the English patent" of Mr. Gwynne's centrifugal pump, to Messrs. Appold and Bessemer, to try the relative merits of the three plans by a year's duty, for £1000, to be paid by the losers to the London Mechanic's Institution.

1844, *Gwynne.*—In 1844, Mr. James Stuart Gwynne undertook a series of experiments at *Pittsburgh, U. S.*, with a view to the development of the central forces. These researches resulted in the invention and improvement of several machines, amongst which is to be reckoned his *Direct Acting Balanced Pressure Centrifugal Pump*, the first public exhibition of which occurred in January, 1849, at the *Passaic Copper Mine.* There he erected a pump 12 feet in diameter, and in 1850 obtained a patent for the invention in the *United States.* Its form and arrangement are detailed in our Plate 76, of the *August* Part of the *Practical Mechanic's Journal.*

1845, *Bessemer.*—Mr. Henry Bessemer, of Baxter House, well known for his several ingenious mechanical improvements, entered the lists as an improver of the centrifugal pump in 1845. Our fig. 8 is a vertical section of a machine, which forms the subject of a patent granted to him at this date, bearing the title of "Certain improvements in atmospheric propulsion, and in certain apparatus connected therewith, part or parts of which improvements are applicable to the manufacture of columns, pipes, and tubes; the other parts are applicable to the exhausting and impelling of air, *and other fluids generally.*" This apparatus appears to be the first ever patented by Mr. Bessemer, and the basis on which he founds his sweeping claim of originality.

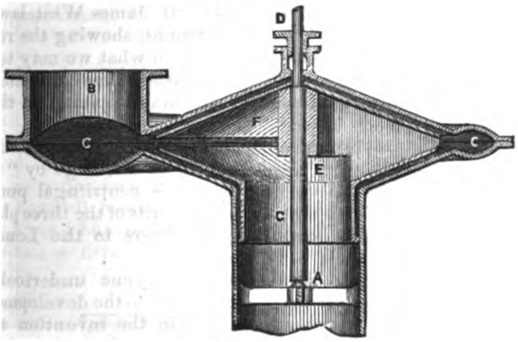
Fig. 8



It consists of a circular cast-iron case, A, divided into two compartments

by the division piece, B, cast in one piece with the rim of the case. One of these compartments contains the apparatus for *exhausting the air* (as described in the specification), and the other is occupied by an emission engine, C, which he employs for driving the apparatus. The rotatory apparatus consists of two metal discs, D and E, placed parallel to each other, and united by a series of flat radiating arms or blades, F, twelve in number, and projecting inwards from the periphery about half-way towards the centre. The whole is surrounded by a perforated metal plate, G, or wire gauze may be employed for this purpose. This perforated rim is for the purpose, as the patentee describes, of preventing the compressed air contained in the case from returning and interfering with the action of the blades. An opening, H, is formed in the case, corresponding to a similar opening in the disc, D, and serves as the inlet to the machine. The portion of the disc round the inlet opening is slightly raised, and placed so that the disc may be brought into close proximity with the case, without being in actual contact with it. The discs are connected with the driving-shaft, I, by a small plate keyed on to the shaft, and bolted to the interior of the large disc, E. The driving-shaft works in two stuffing-boxes cast on to the sides of the chamber containing the emission engine, which is of the ordinary construction, consisting simply of two arms, with their extremities curved in opposite directions, and supplied with steam by the shaft, I, which is made tubular as far as the portion containing the arms. The outlet for the compressed air is formed in the case at J. This pump will either exhaust or compress, accordingly as the pipe is attached to the opening, H or J. It is to be remarked, that throughout the description of this machine, nothing whatever is stated in the specification of employing it for the purpose of raising water. This is the machine placed by Mr. Bessemer

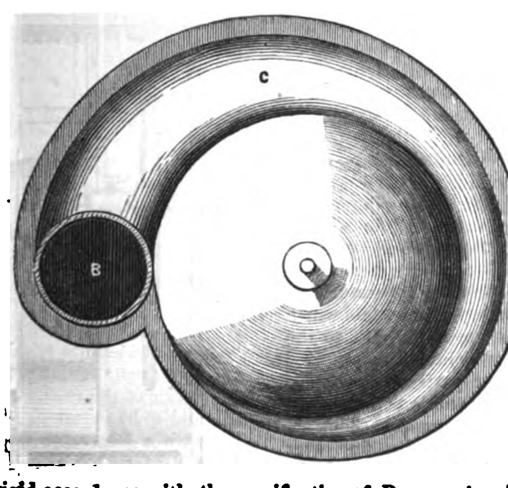
Fig. 9.



in the Exhibition, bearing upon its unblushing face the following incorrect inscription:—

"This model of a Centrifugal Pump for forcing fluids, is constructed

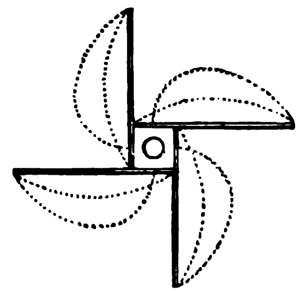
Fig. 10.



in rigid accordance with the specification of Bessemer's original patent, dated Dec. 5, 1845, being the first recorded invention for impelling fluids by the centrifugal force generated in a revolving disc."

1846, *Andrews' Improved.*—After employment on a great variety of work, Mr. Andrews' original pump of 1839 was again improved and patented in the United States, in March, 1846. This pump, the right to which has since been purchased by Mr. Gwynne, is delineated in the three views, figs. 9, 10, and 11. Fig. 9 is a tranverse vertical section through the case, hollow disc, and suction and discharge pipes; fig. 10 is an external plan corresponding; and fig. 11 is a plan of the four eccentric blades, with the square boss by which they are attached to the shaft. In the introductory description given in his specification, Mr. Andrews states that these improvements are the results of his "experience in discharging water from wrecked vessels, in which sand, gravel, and other matters mingle with the fluid pumped up;" and adds, "It is well known that revolving parts of centrifugal pumps are sometimes tubes, and sometimes vanes or arms working within a fixed case, with which the suction and forcing pipes communicate. In my pump I use vanes, and I enclose them within, and connect them to an additional case, which revolves with them, within the exterior or stationary case." In our figures, the vertical pipe, A, opening into the centre of the right-lined portion of the case, is the suction-pipe leading to the water to be elevated; and the short vertical branch, B, at the termination of the external expanding elliptical channel, C, is the delivery passage. The vanes, four in number, are set eccentrically on the shaft, D; and, as described by the patentee, are usually flat blades, as represented by the full lines of fig. 11, but are sometimes curved to the forms of the dotted lines. Their lower edges extend below the lower end of the squared bosses, and each has a portion removed, as at E, with the view of enlarging the passage-way of the water rising out of the suction-pipe into the compartments formed by the vanes. The case is similar in section to that of Mr. Andrews' earlier pump, being formed by two hollow cones, whose bases approach, but do not touch, each other; and set at a distance apart, equal to the depth of the small ends of the vanes. The depth of these tapered ends, and consequently of the space left between the peripheries of their conical covers, through which the water is thrown only by centrifugal force, is proportioned to the depth at the wide ends, so as to keep a sufficient volume of water within the revolving case, to fully supply the circular exit space; and by keeping a greater body of water revolving, increase the centrifugal force, enabling the pump to elevate water to a greater height with a given number of revolutions, and saving something in friction. As already quoted from the inventor's specification, the blades are enclosed within a hollow revolving case, F, working just clear of the external fixed case, and having a short projecting pipe, G, working within the head of the suction-pipe, its open end admitting the water from the latter into the revolving case. The shaft is passed through the upper side of the fixed case, in the centre of the cones, by a stuffing-box, and is supported on a projecting centre bearing, carried by cross-arms, in the suction-pipe.

Fig. 11.

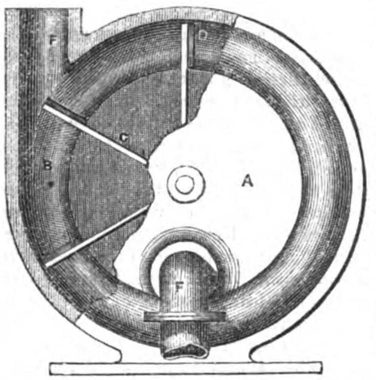


We have, in this pump, the first approach to the present improved *disc* form, and Mr. Andrews has certainly a fair claim to be considered as the originator of what is now the *Disc Pump.* The water drawn through the central opening is thrown from the vane compartments, by the annular opening between the two peripheries of the revolving cone disc, into the spiral elliptical channel, the gradual enlargement of which towards the point of discharge, admits of the fluid being kept moving with the same velocity in all its parts, and prevents loss of power by friction. The points on which Mr. Andrews lays the chief stress, as improvements, are the arrangement of the vanes on the shaft, their taper, the hollow revolving cones carrying the vanes, the junction of the pipe, G, with the suction-pipe, and the spiral discharge channel.

1846, *Von Schmidt.*—In the same year, the Messrs. Von Schmidt, of New York, followed with another modification of considerable novelty. Fig. 12 is a side elevation of this contrivance, with a portion of the fixed external case in vertical section, to show the actuating blades, and the form of the annular water channel. The fixed case, A, is a flat hollow disc made in two halves, bolted together round their periphery. Each half is perfectly flat within the space enclosed by the annular channel, B, and the two being set parallel together, a narrow space is left between the two, sufficient to permit the narrow arms, C, to work clear between. These arms, six in number, carry flat circular vanes or paddles, D, fitting to the channel, B, which is of circular transverse section, and placed concentrically with reference to the driving-shaft and the flat parallel portion of the disc. The suction-pipe is at

E, opening into the side of the fixed case, just within the annular channel, and the water thus taken in by the rotatory action of the vanes is expelled by the tangential discharge passage, F, in a continuous stream.

Fig. 12.



1848, *Appold.*—In Nov., 1848, Mr. Appold brought out a model of a rotatory pump, as a convenient means of draining marshes, and instituted a series of experiments on it with 6, 24, and 48 arms or vanes. This pump attracted some attention at the meeting of the British Association in Birmingham, in 1849. Fig. 13 is a sectional elevation of the original six-vaned pump; fig. 14 is a side elevation of the elevating disc detached; and fig. 15 is an elevation of one of the vanes, with a portion of the central disc to which the vanes are attached. This is the form of one erected

Fig. 13.

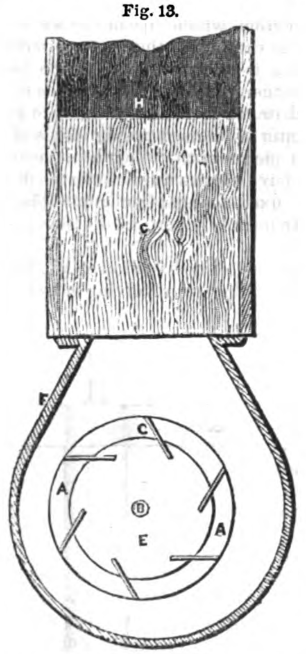


Fig. 14.

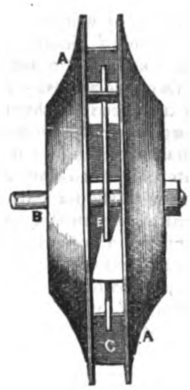


Fig. 15.

on the inventor's premises in Wilson Street, Finsbury: A A, Are the outer discs of the cylinder, fast on the shaft, B; and C C, are the fan-blades held by the outer discs and the central plate, E. These fans, six in number, are set at an angle of 45°, with the diametrical line of the discs. The driving-shaft has a bearing on one side only, where it passes through a stuffing-box in the case, F, which opens up into the bottom of a rectangular delivering-case, G. The openings round the periphery of the cylinder are 1 inch wide, and at the centre the outer discs are 4 inches apart. The water to be raised is admitted through central openings in the outer discs, and as the cylinder revolves at a high rate, it issues, under the compulsory power of centrifugal force, by the circumferential openings, and is thence forced up the delivering channel to the discharge-opening at H, which, in our view, is placed low down, to bring the illustration within a convenient space. The opening on the top of the case, F, is 9 inches by 7 inches, and the wooden case, G, which carries the water from it to the required height, is 10 inches square. The discharge-opening in this case is 6 feet above the water level, made so as to close when the water is to be raised higher up. The cylinder, with its case, stands in a cistern of water, 6 feet by 3 feet, and 3 feet deep, giving about nine gallons for each inch in depth. At a speed of 540 revolutions per minute, the discharge in this time was 1,093 gallons; this being all passed through an annular opening, 1 inch wide by 38 inches in circumferential length.

In later modifications, Mr. Appold has substituted curved blades for the straight ones, shown in the last three figures, and straight parallel sides of the fixed case and vanes, instead of giving a contracted delivery-opening round the periphery, as delineated in fig. 14. Fig. 16 is a side

Fig. 16.

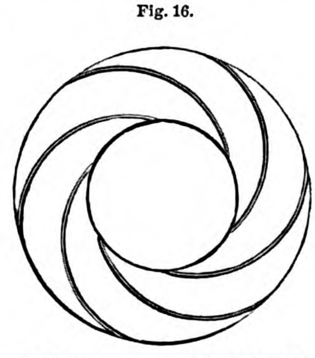
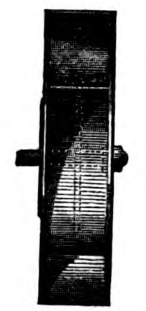


Fig. 17.



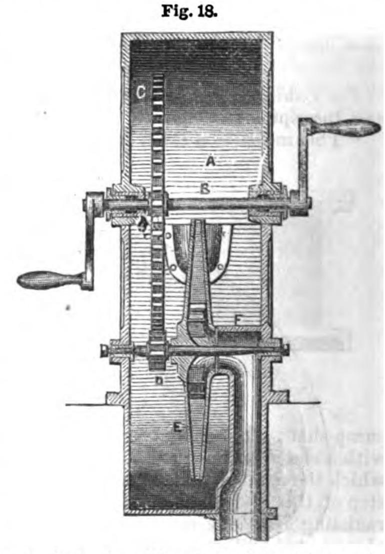
elevation of this form of revolving-bladed disc, with six arms; and fig. 17 is a corresponding edge view, showing the rectangular section of the case. Mr. Appold has stated that the curved blades discharge more water than the straight ones; but in changing the sectional form of his case from the form of fig. 14 to the rectangular one of fig. 17, we are afraid he has committed a serious error.

How far the statement in the *Times* is supported by the facts of the preceding history, we leave "candour-loving Englishmen" to decide. As to the relative merits of the pump by Mr. Gwynne, and the hydraulic engines by Mr. Appold and Mr. Bessemer, brought under public notice in the Exhibition of the Industry of all Nations, the *unaccepted* "challenge," published by Mr. Gwynne, affords conclusive evidence on which side public opinion preponderates.

1849, *Bessemer.*—In 1849, we find Mr. Bessemer with an improved edition of his pump of 1845.

Fig. 18 is a vertical section of what he terms his *Disc, Lift, or Suction Pump*, as fitted up to be worked by two hand-winches. The whole mechanism is contained in the cast-iron case, A, rectangular in horizontal section, and curved at top and bottom. The first motion-shaft, B, on the ends of which are the actuating winches, is passed through the sides of the upper part of the case by two stuffing-boxes, and has keyed upon it, inside the case, a large spur-wheel, C, gearing with a toothed pinion, D, fast near one end of the second motion-shaft carrying the pump-disc, E. This disc is composed of two circular metal plates, connected by a series of intermediate radial leaves, or divisions, which answer as a hold for the water in passing through the pump, and give the water the full benefit of the centrifugal force. The shaft of this disc is mounted in brass bushes, set in eyes cast in the sides of the case, on the outer ends of which eyes are screw cups, with elastic washers beneath their heads, to prevent the escape of water. The hollow disc is in reality composed of two separate plates, slightly dished, one of which has a boss, by which it is keyed on its shaft; whilst its opposite one has a central aperture, or mouth, with a faced edge to fit truly, without absolute frictional contact, to the fixed mouth or faced end of the upper rectangular portion of the passage, F. This passage is cast on the inside of the case, and its lower end opens into the pipe leading to the fluid to be elevated. The foot of this pipe is provided, in the usual way, with a foot-valve for the retention of the water-column when the pump is at rest. The radial plates in the disc are narrowed towards their outer ends, in order that the space between the plates may be reduced in width, in correspondence with the increased distance between each partition. The inventor states

Fig. 18.



he has obtained good results from discs with an area of central mouth-piece equal to the annular opening in the periphery; but he prefers that the latter area should be one-third less than the former.

Fig. 19 is a partial vertical section of Mr. Bessemer's *Disc Forcing Pump*. The hollow disc, A, is formed either in two pieces, in the manner described in his previous modifications, or cast in a solid piece. It revolves inside the cast-iron chamber, which has two short elbow passages, B B, opening upwards into the lower ends of the two branches, C, joined together above, to form the delivering-main. The driving-shaft, D, on the lower end of which the disc is keyed, revolves in a footstep in the bottom of the case, and is supported above by a collar-bearing, E, bolted to the side of the water-main above. The cover of the fixed case is formed with a wide central aperture, into which is fitted the bottom disc-flange of the inverted expanding cone, F, open at the top, for admitting the fluid to the interior of the revolving disc, through the central aperture in the latter, the edges of which are faced to work against a corresponding face on the under side of the cone disc. It is obvious that pumps of this kind must be immersed some distance beneath the level of the fluid to be elevated, so that it may find its way into the cone, from which a constant delivery is made into the case—the pressure so arising, forcing the water up the branches, C, to the main above.

Fig. 19.

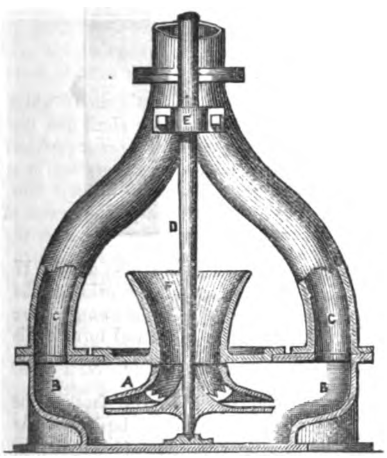
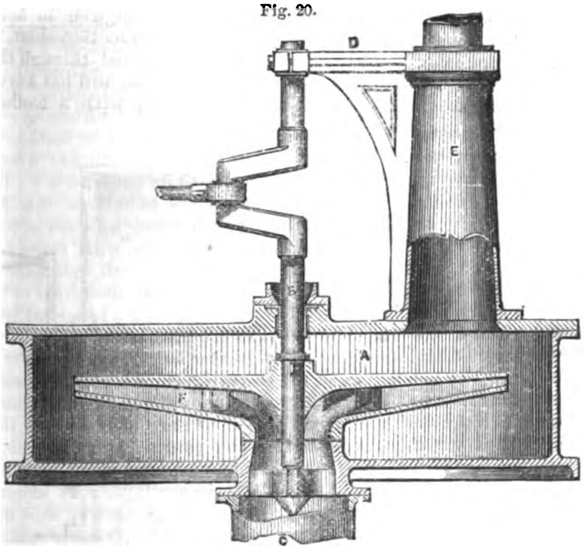


Fig. 20 is a vertical section of this form of disc pump, adapted to be worked by an oscillating steam-cylinder, by means of a crank on the pump-shaft. The shallow cylindrical case, A, containing the disc, is cast with a closed bottom, and has a cover bolted on its upper side, through which the main-shaft, B, is passed by a central stuffing-box. The footstep of this shaft is carried in the centre of a boss, supported by four radiating arms cast in the short central branch-pipe opening into the lift-pipe, C, communicating with the reservoir of supply, whilst the upper end of the shaft revolves in a collar-bearing in a bracket, D, cast on the top of the hollow column, E, forming the rising main, or discharge outlet for the elevated fluid. The actuating engine oscillates horizontally on trunnions in standards, bolted to the top of the case-cover. The disc, F, is constructed in the same way as in the last-described example, and is keyed near the lower end of its driving-shaft, with its central aperture coinciding with the open branch cast on the bottom of the case, the edges of the two surfaces being in close contact. The disc answers as the fly-wheel of the engine, and the centrifugal action, when in motion, is such

Fig. 20.



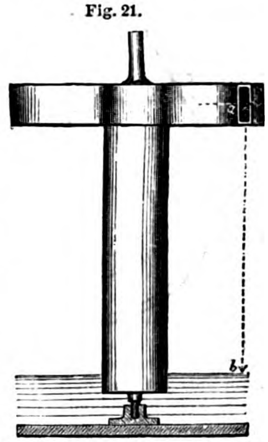
that the water is drawn up through the pipe, C, past the boss of the lower bearing of the shaft, which is coned to diminish the resistance, and is thrown out from the periphery of the disc into the case, and the continued pressure so produced carries up the water through the column, E, to the point of discharge.

None of these machines being like the one exposed to the examination of the jurors in Hyde Park, it is fair to assume, that in the latter we are presented with the great improvement alleged to have been made by Mr. Bessemer. The public will, however, be likely to conclude, that were Mr. Andrews' last form of pump placed in an open instead of a closed case, we should have the identical "drainage-pump" exhibited by Mr. Bessemer. That conclusion would be so far true; but any weight which might attach to it would disappear when the vast importance of the closed case was considered. It constitutes, in fact, the difference between pump and no pump. The public might also be led to observe another ground of similarity in the presence of four wooden boards, placed, it is said, by the jurors, to prevent the water from rotating in the case; but these boards, the public will be surprised to learn, are exact counterparts of Mr. Gwynne's stop, B, in fig. 2, plate 76 of our last number, and a direct infringement of one of the claims of his patent.

1846, *Whitelaw.*—So far back as 1846, Mr. James Whitelaw of Johnstone turned his attention to this form of pump, as applicable for drainage or other purposes, where large bodies of water are to be elevated to a limited height; and, in 1850, designed a machine for the purpose.* In his matured plan, a vertical shaft carries a short hollow case, cylindrical for about half its depth, and conical downwards to the bottom, which dips in the water. It is thus a cylinder and a truncated cone combined, the water entering it by the narrow open lower end of the cone. Round the top of the case is an annular channel of rectangular section, revolving with the case, and fitting over a fixed-open topped duct or receiver, also annular to correspond. As the case revolves, the water is carried up the inside of the cone until it reaches four sloping jet-pieces in the upper annular channel, and through them the centrifugal force carries the fluid for discharge, at the termination of the jets, into the fixed channel beneath. The case is divided internally into four compartments by vertical division pieces, corresponding with the four discharge jets.

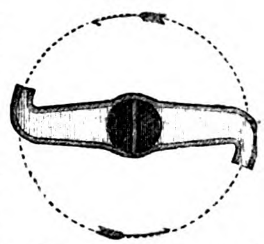
Fig. 21 is an elevation of another suggested modification of Mr. Whitelaw's, and fig. 22 is a horizontal section of the two revolving radial arms. The inventor experimented very carefully with this model, the height, *a b*, to which the water was lifted being 1·882 feet, and the diameter of the pump, or the distance from centre to centre of the jet orifices, was $18\frac{1}{16}$ inches, or 1·5052 feet. The greatest result obtained in these trials was 76·97 per cent. of the applied power. Mr. Appold only claims for his pump 70 per cent. of effective duty, and that result is paraded before the world as an astounding one. Unfortunately for the credit of the claim, it is well known, that two years prior to Mr. Appold's wonderful discovery, Mr. Whitelaw had constructed a pump capable of doing nearly 7 per cent. more duty than the astounding water-raising engine of the Exhibition of 1851. Those who are acquainted with the modern form of Mr. Whitelaw's reaction water-mill, will see that the same general form has been adopted here, the entire apparatus being simply an improved Barker's mill reversed, the water entering the open lower end of the hollow vertical tube, and being expelled by the jets at the curved terminations of the two arms.

Fig. 21.



Mr. Whitelaw also proposed another extremely simple plan for elevating water to moderate heights, consisting of nothing more than a pair of discs, hollowed or recessed in the same direction, so that one fits within and above the other, leaving a narrow water-space between. Both are fast near the lower end of a vertical shaft; and the lower outer one being open at the centre, and immersed in the water, the fluid rises up by the action of the centrifugal power, when the pump is set in motion, and passes out in the form

Fig. 22.



* Full illustrative particulars of the various forms proposed by Mr. Whitelaw are given at p. 4, vol. iii. *Pract. Mech. Journal.*

of a thin annular sheet at the peripheries of the discs. These peripheries are slightly inclined towards the centre of the shaft, so as to counteract the tendency of the water to fly off from the centre the moment it quits the disc. By this plan the water is in contact with the discs only for a very short time, as it is elevated far above their level, and discharged into a fixed annular receiver, solely by its accumulated momentum.

1850, *Gwynne.*—In June of this year, Mr. J. S. Gwynne, then in New York, made application for an English patent for his *Balanced Centrifugal Pump*, together with other applications of the central forces, under the title of "A new and useful improvement in condensing air, or other elastic fluids, and for improvements in motive power; also, for propelling vessels, pumping fluids, and for other purposes," which patent, under an altered title, was granted in August, 1850. On discovering the alteration in the title, which was made without his knowledge, and completely excluded his pump, Mr. Gwynne applied for a new patent in January, 1851, and obtained the grant in March of the same year.

We have already illustrated this ingenious invention in very full detail, and we now proceed to exemplify a few of its actual arrangements for specific purposes. The particular adaptations which we have selected as explanatory delineations for the use of the constructive engineer, are three:—

1st, As an air-pump for marine engines.

2nd, As placed within the external water-chamber of the condenser, to act as the air-pump of a stationary engine.

3rd, As the air-extractor for taking off the atmospheric pressure from Howard's vacuum sugar-pan.

Our plate 77, exhibits the whole of these arrangements in one view.

Fig. 1 is a side elevation of the marine engine air-pump, with its attendant apparatus, the condenser, foot-valve, and hot-water discharge valve-chests, being shown in vertical section. The external case, A, cast in two halves, and attached together by an external ring of bolts, is provided with a base flange for bolting the whole down to the timber, B. The water is taken from the condenser by the foot-valve, C, opening into the short curved pipe, D, the opposite open end of which pipe admits the water through the external fixed case into the concavity of the revolving discs, by their central side opening. The hot-water discharge is by the upper side pipe, E, leading into the discharge valve-chest, F, whence it is conveyed away by the vertical pipe springing from the top of the condenser. The connection of the pump with the condenser is thus of the simplest and most inexpensive kind; whilst the rotatory movement of the discs is obtained by equally simple means, from the crank or paddle shaft.

The second arrangement, fig. 2, as adapted for stationary engines, shows the whole internal details of the mechanism. In this view, all the parts are delineated in vertical section—the section of the pump being in a line at right angles to the elevation in fig. 1. The case, A, of the pump, is bolted down to the bottom of the external water-chamber, B, surrounding the condenser, C. The pump is thus entirely concealed from view, whilst the essentials of compactness are fully insured. Motion is given to the pump by the band pulley, D, on the outer end of the horizontal shaft, carrying the pump discs. This shaft is supported externally by a pillar, D, springing from the floor, and is passed through the side of the chamber, B, by a stuffing-box, its opposite end being supported in a bearing in the centre of the fixed branch, G, forming the communication between the pump and the condenser. The waste steam from the cylinder enters the condenser by the upper pipe, H, thus meeting the water-jet from the rose-pipe, I. The curved pipe, J, conducts the water from the condenser to the pump, and the discharge is by the short branch, K, opening into the external water-chamber. Thence the water flows off by the pipe, L. By this plan, nothing connected with the pump, but the driving-pulley and end of the shaft, can be seen from the outside.

Figs. 3 and 4 exhibit the third of our enumerated list of adaptations. Fig. 3 is a side elevation of the pump, with its pipes complete, as attached to a sugar vacuum pan, delineated in vertical section. Fig. 4 is a corresponding plan of the whole apparatus. The shell, or case, of the pump, A, is bolted down to the bottom of the water-chamber, B, the driving-shaft carrying the pulley, C, being passed horizontally through the side of the chest by a stuffing-box, and supported externally by a pillar, D. The pump's external communication is by the short branch, E, opening into the centre of the case, and bolted at its other end to the inside of the chest, B, where it is connected to a line of pipe passing to the top of the pan, for keeping up the vacuum. The high-pressure steam for boiling the sugar is supplied by the pipe, F, to the coil of pipes in the bottom of the pan, in the usual way, the vapour being carried off by the action of the pump along the pipe, G H, where it is met by the condensing jet of the pipe, L. The fluid is hence conveyed through the pump, and discharged by the exit pipe, J, into the chest, whence it flows away by the pipe, K.

1850, *Bessemer.*—During this year, Mr. Bessemer further developed his pump, by the exhibition on his premises of a submerged horizontal disc for raising water.

1851, *Bessemer.*—In the early part of the present year he explained his invention before the boys of the Harrow school, when it appeared to be simply a horizontal disc revolving in water.

So ends our *Historical Review.*

GENERAL VIEW OF GEOMETRY.

II.

If we attentively examine those geometrical investigations which appear not to relate to the *measurement* of extension, we shall find that they essentially consist of inquiries as to the *properties* of lines or surfaces; that is to say, of a knowledge of the different modes of generation, or at least of definition, proper to each form coming under consideration. Now, it is easy to prove, in a very general way, the necessary connection of such inquiries with the question of *measurement*, in order to which the fullest possible acquaintance with the properties of each form is an indispensable preliminary. Two considerations, of equal importance, but of entirely distinct natures, concur to establish this position.

The first is purely theoretical, and consists in this, that if we were acquainted with no other characteristic property of each line or each surface than that by which it was known to the early geometers, it would, in most cases, be impossible to solve the problems connected with their measurement. In fact, it is easy to see that the different definitions of which each form is susceptible are not all equally suited to this end, and that even under this aspect they present the most complete opposition. Now, on the other hand, the primitive definition of each form, not having been selected with reference to this purpose, it is clear that we ought not to expect, in general, to find it the most suitable; and hence flows the necessity of discovering others, that is to say, of studying as far as possible the *properties* of the given form. Let us suppose, for example, that the circle is defined as the curve which encloses the largest space within the same length of including line, a property truly characteristic, we should experience insurmountable difficulties in attempting to deduce from this definition the solution of the capital problems connected with the rectification or the quadrature of this curve. It is clear, *à priori*, that the property of having all its points at an equal distance from a fixed point must necessarily be better adapted for inquiries of this nature without being generally the most suitable. Thus, would Archimedes ever have been able to discover the quadrature of the parabola, if he had known no other property of this curve than that it was the section of a cone, with a circular base, made by a plane parallel to its generatrix? The purely speculative labours of preceding geometers to enlarge this last definition were indispensable preliminaries to the direct solution of such a problem. The same holds good still more strongly with respect to surfaces. It would suffice, for example, to compare, with reference to the problem of the cubature or quadrature, the ordinary definition of the sphere with that, no less characteristic, which describes a spherical body as that which within the same area contains the greatest volume.

There is no need that I should show at greater length the necessity of understanding, as far as possible, all the properties of each line or surface, in order to facilitate the search for rectifications, cubatures, and quadratures, which constitutes the final aim of geometry. It may even be said that the principal difficulty of questions of this kind consists in the search, or employing that particular property which, in each case, is best adapted to the nature of the given problem. Thus, in continuing to indicate the measure of extension as the general object of geometry, this first consideration, which goes to the bottom of the matter, clearly demonstrates the necessity of studying to the utmost the different generations or definitions proper to the same form.

A second consideration, of not less importance, consists in this, that such a study is indispensable for the philosophical organisation of the abstract and the concrete in geometry.

Geometrical science having to consider all the conceivable forms which admit of an accurate definition, it necessarily results that problems relative to all the forms presented by nature must, when it has reached its state of perfect development, be implicitly comprised in it. But when we would pass on to concrete geometry, we always encounter a fundamental difficulty, that of knowing to which of the different abstract types we ought to refer, with a sufficient degree of approximation, the lines or the surfaces which we have to study. Now, it is for the purpose of establishing such a relation that an acquaintance with the greatest possible number of properties of each geometrical form becomes quite indispensable.

In truth, if we were always restricted to the single primitive definition of a line or a surface, supposing even that we could then *measure* it, (this being, however, according to the first class of considerations, in most cases impossible,) our knowledge would remain almost necessarily sterile in its application, seeing that we should not be able to recognise this form in nature when presented to us. To effect this, it would be requisite that the character adopted and investigated by geometers should be precisely that of which external circumstances should admit a verification, a coincidence purely accidental, the recurrence of which, though it may sometimes happen, cannot be reckoned upon. It is, therefore, only by multiplying as much as possible the abstract characteristic properties of each form that we can be sure of recognising it in the concrete state, and of thus turning our philosophical labours to account, by verifying in each case the definition which is capable of being directly proved. This definition is almost always constant in the circumstances stated, but varies with different circumstances—a twofold reason for determining it.

Celestial geometry furnishes us, in this respect, with a striking example of the necessity of such a study. It is known that Kepler perceived that the curve described by the planets round the sun, and by the satellites round their planets, is an ellipse. Now, would this grand discovery, which threw a new life into astronomy, have been possible, if geometers had been always restricted to the conception of an ellipse as the oblique section of a circular cone by a plane? No such definition can evidently admit of a similar verification. The best known property of an ellipse, that the sum of the distances of all its points to two fixed points is constant, is doubtless by its nature capable of identifying the curve in this case; but it still is not directly suitable. The only character which can be immediately verified is that drawn from the relation which exists in the ellipse between the length of the focal distances and their direction; the only relation which admits of an astronomical interpretation, as expressing the law which connects the distances of the planet from the sun, with the time elapsed since the beginning of its revolution. It was therefore requisite that the purely speculative labours of the great geometers on the properties of conic sections should have previously presented their generation under a variety of aspects, in order that Kepler should thus have been able to pass from the abstract to the concrete, by selecting from amongst all the different characters that which could be most easily verified by the planetary orbits.

The problem as to the earth's figure may be cited as an example of the same class in connection with surfaces. If we had never known any other property of the sphere than its primitive character of having all its points equally distant from a single point within it, how should we ever have been able to discover that the surface of the earth was spherical? It was previously necessary for this end that we should deduce from that definition of the sphere some properties capable of being verified by observations made at the surface only; as, for example, the constant ratio which exists between the distance passed over in moving towards one of the poles in the same meridian, and the angular height of the pole above the horizon at each point. And so it occurred after a much longer series of preliminary speculations, in order to prove that the earth was not exactly spherical, but has the form termed an ellipsoid of revolution.

It would be a useless labour to give further instances, since every one will easily find them for himself. The result, however, will be this, that without a very wide acquaintance with the different properties of each form, the relation of the abstract to the concrete in geometry will be purely accidental, and consequently the science would want one of its most essential foundations.

Such, then, are the two general reasons which plainly demonstrate the necessity of introducing into geometry a great number of investigations, the immediate object of which is not the *measurement* of extension, whilst we still continue to regard such measurement as the ultimate aim of all geometrical science. Thus we can retain the philosophical advantages offered us by the neatness and precision of this definition, and can properly, though indirectly, include every species of geometrical investigation, by considering those which do not appear to refer to the *measurement* of extension, as destined either to prepare the way for the solution of final problems, or to further the application of solutions already obtained.

Recognising, then, the intimate and necessary relations of the study of the properties of lines and surfaces with the investigations which constitute the ultimate aim of geometry, it is, moreover, evident that geometers ought by no means to fetter their exertions by keeping such relations strictly in view. Knowing, once for all, how important it is to vary as much as possible the manner of conceiving each form, they ought to pursue their studies without pausing to consider of what immediate utility such and such a special property may be in rectifications, quadratures, or cubatures. If they attached too much importance to the continuity of this co-ordination, they would uselessly fetter their investigations. The mind ought to proceed in this instance, as it does on all similar occasions, when, after having taken a general survey of the object of a given study, it devotes itself entirely to extend the limits of its domain, without considering those matters that would impede its labours.

The general explanation just given is the more required, since, by the very nature of the subject, this study of the different properties of each line and each surface necessarily composes by much the largest part of geometrical investigations. In fact, the problems immediately concerned with rectifications, quadratures, and cubatures, are evidently of a very limited number for each form to be considered. On the other hand, the study of the properties of any given form presents an endless field for investigation, and one in which new discoveries may always be hoped for. Thus, for instance, although conic sections have occupied the attention of geometers for the last twenty centuries, this simple subject is far from being regarded as exhausted; and we may still expect to derive from its further cultivation a knowledge of properties at present unknown. If labours of this kind have been much relaxed for the last century, it is not because all their objects have been attained; it is owing solely, as I shall shortly explain, to the revolutions effected by Descartes, whereby the importance of such investigations has been much diminished.

The preceding considerations will have shown, that not only is the field of geometry necessarily infinite, by reason of the variety of forms to be considered, but also in consequence of the diversity of the points of view from which the same form can be considered. The latter conception is in truth that which gives us the largest and completest idea of the range of geometrical investigations. It is seen that studies of this class essentially consist in attaching all the geometrical phenomena presented by each line, or each surface, to one single fundamental phenomena, regarded as the original definition.

In order to complete the preceding sketch of the philosophic character of geometry, there remains to consider the proper method to be pursued in forming this science. The entire number of geometrical problems may be treated according to two methods, which are so different, that it may be said two geometries are the result; the philosophic character of which does not seem to me to have been hitherto properly seized. The expressions, *synth tic* geometry, and *analytic* geometry, habitually employed to designate them, give rise to such false ideas regarding them, that I shall make use of the terms *special* geometry, and *general* geometry—terms which appear to me to mark out with precision the true nature of the two methods.

The difference in the manner of treating geometry before and since Descartes, does not consist, as is commonly supposed, in the employment of the calculus. For, in the first place, it is certain that the calculus was not entirely unknown to the old geometers, since they made frequent and extensive applications of the theory of proportions, which was a substitute for our algebra, though an imperfect and extremely limited one. In the second place, however capital may be the influence of the calculus in our geometry, several solutions obtained without algebra can sometimes exhibit the peculiar character which distinguishes it from the ancient geometry, although, generally speaking, the analysis is indispensable. I may cite, in illustration, Roberval's method for tangents, the nature of which is essentially modern, and yet it conducts, in certain cases, to complete solutions, without any aid from the calculus. It is not, therefore, by the instrument of deduction employed that we must chiefly distinguish the two paths available in geometrical investigations.

The difference appears to me to consist in the very nature of the problems themselves. Geometry, as we have seen, when it is surveyed as a whole in its state of perfection, ought, on the one hand, to include all conceivable forms, and on the other to disclose all the properties of each form. It may therefore be treated on two methods, entirely distinct; either by grouping together all problems, how diverse soever, which relate to one form, and laying apart those which relate to other forms, how close soever may be the analogy between them; or, on the other hand, by bringing together under the same point of view all analogous investigations, notwithstanding they relate to different figures, and by separating the problems which are concerned with different properties, although the same figure remains under consideration. In a word, geometrical questions may be classed either with reference to the bodies studied, or to the phenomena to be considered. The first is the most obvious course, and it was that of the ancients; the latter, much more scientific, has been that of the moderns since Descartes.

The principal character of the old geometry was, that it studied the different lines and surfaces one by one, not passing to the examination of a new figure until it was believed that everything of interest in those already known had been exhausted. In this manner of proceeding, when the study of a new curve was undertaken, all preceding labours were

unable to afford, directly, any important resource beyond the exercise and cultivation which the mind received from those labours. How similar soever were the problems arising out of two figures, the results obtained from the investigation of one would by no means enable us to dispense with another investigation with regard to the other figure. Thus the mind had never any assurance of advance, since it could never beforehand be certain of obtaining any solution, how analogous soever was the problem proposed to the problems already resolved. Thus, for instance, the determination of the tangents to the three conic sections supplied no real aid for carrying the tangent to any other new curve, such as the conchoid and cissoid. In a word, the geometry of the ancients was, as we have expressed it, essentially *special*.

In the modern system, geometry is, on the other hand, eminently *general;* that is to say, embracing all forms whatever. It is easy to understand that all geometrical problems, possessing any importance, may be proposed with respect to all imaginable figures. This is quite evident as to those capital problems which constitute, as previously explained, the ultimate aim of geometry; that is to say, rectifications, quadratures, and cubatures. But it is no less incontestable, even as to those researches which relate to the different properties of lines and surfaces, the most essential of which—such as the problem of tangents or tangential planes, the theory of curves, &c.—are evidently common to all figures soever. The investigations, very few in number, which are really peculiar to any given figure, are of minor importance. This being understood, modern geometry consists essentially in laying aside, for separate treatment, every problem concerned with the same geometrical phenomenon, in whatever bodies it may be considered; and this is done in the most general manner. The application of the general theories thus constructed to the special determination of the phenomenon under consideration in each particular body, is regarded as only an inferior work, to be performed under the guidance of unvarying rules, the success whereof is certain beforehand. This labour is, in short, of the same rank as the numerical evaluation of a determinate analytical formula; and no other merit can be claimed for it than that of presenting a solution, already involved in the general method, with all the simplicity and elegance which the given line or surface will admit of. But importance is attached only to the conception and to the complete solution of a new problem peculiar to some given form. Labours of this kind are alone regarded as truly advancing science. The attention of geometers being thus freed from the examination of the details of the different figures, and being entirely devoted to general questions, is thereby able to ascend to the consideration of new geometrical ideas, which, being applied to the curve studied by the ancients, have led to the discovery of important properties, of which they had no suspicion. Such is geometry since the grand revolution in the general system of the science effected by Descartes.

The immense superiority of the modern geometry over the ancient will be evident from this sketch of their difference. It may be truly said, that before Descartes' grand conception, scientific geometry was not really placed upon its true basis, as regards either its abstract or its concrete relation. Considering the science speculatively, it is clear that, in continuing to pursue the ancient method, as did the moderns before, and even a little after Descartes, adding a few curves to those already studied, the advance, if as rapid as possible, would have been but small, at the end of a long series of ages, compared with the infinite variety of forms which would remain to be studied. On the other hand, by each problem solved after the modern method, the number of problems remaining unsolved is once for all so much diminished in relation to all possible bodies. Under a second point of view, for want of general methods, it followed that the ancient geometers, in all their investigations, had to rely entirely upon their own proper forces, without ever having the certainty of obtaining, either soon or late, any solution whatever This imperfection of the science might draw out to the full their admirable sagacity, but it would render their progress extremely slow, of which we may form some idea from the length of time they employed upon conic sections. Modern geometry, however, invariably giving us assurance of our advance, enables us to husband the powers of the intellect to the utmost, whilst the ancients frequently wasted them on unimportant questions.

A difference no less capital between the two systems is manifested when we come to consider geometry under its concrete aspect. We have already remarked that the relation of the abstract to the concrete in geometry can only be firmly built upon a philosophic basis, except so far as the investigations are made to apply directly to all conceivable forms. Studying lines and surfaces one by one—whatever be the number, always necessarily very small, of those that we have to consider—the application of similar theories to the forms really existing in nature, would never have any character but one essentially accidental, because we could have no assurance that these forms could enter into the abstract types considered by geometers.

For example, there is something of chance in the happy relation which has been established between the speculations of the Greek geometers on conic sections, and the determination of the true planetary orbits. But there was no ground for hoping for similar coincidences by following up the same method; and it was quite possible that the investigations of geometers might have been employed upon abstract forms not susceptible of a practical application, whilst they neglected those capable of an important and immediate application. At any rate, it is clear that nothing positively warranted the necessary applicability of geometrical speculations. But it is quite otherwise in the modern system, inasmuch as all forms whatever are investigated in a general manner. We have beforehand the certainty, that the forms presented by the external world must fall within one theory or another, if the data are sufficient to bring them within the domain of geometry at all.

From these several considerations, it is seen that the old system of geometry bore evident marks of being produced during the infancy of the science, which only began to be completely scientific in consequence of the revolution effected by Descartes. On the other hand, it is evident that geometry can only be conceived at first in this special manner. General geometry was not possible, and even the necessity of it would not have been felt, if a long series of special labours, on the simplest forms, had not previously furnished Descartes with the basis of his conception, and rendered sensible the impossibility of continuing to pursue the old system indefinitely.

In conclusion, it must be remarked, that although that geometry which I have denominated general must be now regarded as the only true dogmatic geometry—the other having little interest beyond an historical one—nevertheless it is impossible to make this special geometry entirely disappear from a philosophical exposition of the science. No doubt, we need no longer borrow directly from the ancient geometry the results it offers. The longest and most difficult investigations it contains are no longer habitually presented at this day, except by the modern method. But by the very nature of the subject, it is impossible to do without the old system altogether, and it must ever serve for the base of the whole science in exposition, as it has done in history. The reason is readily comprehended. General geometry being essentially founded on the employment of the calculus, on the transformation of geometrical notions into analytical notions, such a mode of proceeding cannot take up the subject quite at its origin. We know that the application of mathematical analysis cannot, by its nature, originate any science whatever, since it cannot arise until the science has been so far cultivated, that some equations can be established to serve for the starting-place of analytical labours. These fundamental equations being once discovered, analysis will permit us to deduce from them a number of consequences which we did not previously even suspect; and it will advance the science to a wonderful extent, both as regards the generality of the conceptions and their mutual co-ordination. But to establish the basis of any natural science, simple mathematical analysis cannot suffice, not even to demonstrate it anew when already founded. Nothing enables us to dispense with the direct study of the subject, as far as the discovery of precise relations is concerned. To endeavour to bring the science, from its very origin, within the domain of the calculus, this would be to impose on theories, bearing upon actual phenomena, the character of simple logical processes, and to strip them thus of everything which constitutes their necessary co-relation with the material world. In a word, such a philosophical operation, if it were not of itself necessarily contradictory, could only end in replunging us into metaphysics, from which the mind has already had so much difficulty in extricating itself.

Thus the geometry of the ancients will always, by its nature, occupy the first place in the entire system of geometrical science. It constitutes an indispensable introduction to general geometry; and to this position it must be reduced in a development of the science which is entirely dogmatic.

HAS THE GREAT EXHIBITION BEEN POPULAR?

This question is better answered as thus put in the past tense, than it could have been when asked in the present. Almost every one has now some reply; whereas, a few weeks ago, unanswered querists abounded. This position of the matter arises from the peculiarity of the Exhibition itself, in not being confined to the productions of labour in one department only, or of one nation, but embracing the embodied forms of thought of all people. Will the Great Exhibition be popular? was asked by those who took an interest in it, standing in all their thousand

different positions. "No," said the purveyor of raw material; "who will come expressly to see my things? A few may be attracted by the articles carefully manufactured from them, but that is all." "No," said the machinist, "although it is I who have been mainly instrumental in bringing this matter about; although I may myself teach, by my simple or intricate instruments, the means of annihilating time and space, and of bringing within sight things made otherwise than by the inventive mind of man, in my calculating wheels and cylinders, I may attract a few amongst my fellow-inventors, and a few more among the 'curious' people abroad." "No," said the manufacturer, "attention will be so divided—on the one hand we shall see the mere natural historian dwelling with interest on the natural products of the different countries—and, on the other, the fine lady and gentleman dilettanteing it in a fine arts court. All my performances will never suit them." "No," again said the sculptor; "what have I to do with the popular mind; it is as a blank to me. To be pleased with the forms which I create, there must be that preliminary discipline which the million have not. To the student, or my fellow-labourer, I may be for a moment attractive, and be loved by some few—some very few—but that is all." "The Exhibition will not be popular," was the universal cry; and all were right, looking at the matter from the particular points upon which they respectively stood—wrong, in that they transferred not themselves to other points of view, and felt the truth, that precisely as each one regarded his own contributions by the side of other contributions, so would the Great Exhibition be not one, but many exhibitions.

If we, for a moment, analyse it in thought, we shall find this to be actually the case. The name of the collections within the great crystal dome is Legion; and every collection has had its hundreds of thousands of inspectors and admirers. With those who admire the rough material only, the other departments are not interesting, and therefore not "popular" to them; so, too, the machinery may be said to be unpopular with those who can see nothing worthy of notice in a vertical printing-press, or a Jacquard loom. Thus, people at first measured the taste not only of others by their own standard, but threw a cloud over things themselves even before they were seen. They placed others, *nolens volens*, precisely in the same predicament as a worthy acquaintance of ours placed himself in our eyes. He is a provincial practitioner of the law, in an English midland county. We casually met him on his way to eat strawberries in Covent Garden Market. We asked him his opinion of the Great Exhibition, and how often he had been to see it; when, with what Mr. Carlyle would call a beaver-like—or something else, we won't say what—inanity, he informed us he had come many times to London since the Exhibition opened, but had never been, and never intended to go. Right—for such as he by all means; for what good in this universe can such a man be to himself or others? To return—Let us only judge of others in another way. I am a manufacturer: Good. I bring together not only the curious and rare productions of my skill, but the useful worki' day things. I bring them together from all points of the compass of my fatherland. I bring them together from every nation and people under the sun. What is the necessary result? I have brought the interest which watched over the fabrication of each one of all my thousand thousand articles to a focus. There it shines out as it shone not out when solitary in India, in Austria, or at home. All are attracted, and come to study a peculiar kind of comparative anatomy, which they find shows many wonders, and teaches many profitable things; all here, however, being left to the kind reader's imagination only, whether he be a manufacturer or not. Now, what can possibly be more popular than this, in the proper sense of the word? All the million do not come to see my stores, but a fair share of them do. Why do not all come? Are there not other collections? Yes, to be sure, they are there as intensely striving to learn something new as their fellow-sightseers in our own hall of manufacture. The Exhibition not popular! Water not wet may some day or other be patented, should such a thought be stereotyped. We do not wish to count the shillings, much less the half and whole crowns, that have tumbled into the Royal Commissioners' treasury. They jingle a sweet music of themselves. The observing and recording eye is the evidence with which we have most been pleased of the popular character of this grand trial of the nations' industries. The fine lady, with her delicate white lace parasol, condescending a glance at anything that is not suited for some kind of personal bedizenment—the superb gent., with silver-headed cane at nose, floating like a stray leaf in a wayward brook, and just as carelessly reviewing what he reviewed yesterday, with not one single glimpse of any new idea, or even fact, supervening on "the rim of his horizon"—are nothing to us. They are there; but we do not require to identify them with popularity, if popularity would herself like to do so, which we doubt. But now turn your eye that way, and see that person in a fustian jacket. Can't you see him? No; he is stooping down to get at the right and wrong of that wheel underneath, and now his eye, like a well-trained sporting-dog, follows the scent he has come upon—suddenly halts, and makes the point as the wind brings down the game. He has conquered the machine, and can carry it home with him, wherever his home may be, without applying to any powers to help him. As he roams from machine to machine, the interstices of his time are still filled up. He may not regard the statues at his side, and the diamonds and pearls of India have no retaining attractiveness for him. He has been compelled (not unhappy he) to find in them no attractiveness at all. See now how genial a pleasure beams from his rough but honest-looking features, as one of his kith and kin receives from his lips an intelligible word or two about the selfsame machine, and how he thinks he can apply it to, &c., &c. Such are of the true people of a nation; the other stragglers are good for nothing but the census, and but falsely good in that, perhaps. Our friend in the fustian is a substantial unit in the popular.

We do not know how many "Guides to the Exhibition" have been published, but they have been numerous, and none appears satisfactory. In perusing them, we can readily perceive the peculiar phase of mind employed in the compilation of each. It has been, indeed, a most amusing task to go through some of them, and notice this. Every one exhibits a dwelling upon a certain class of objects, which demonstrates the calibre of the writer. Other objects, as interesting to others, are passed over with but a name and a place; some are not even noticed at all. The truth is, that the difficulty thus experienced in framing a guide or synopsis arises from the more than ordinary great popularity of the Exhibition. Each one of the populace has *his* set of objects, distinguishable by him at least above others. He asks for a guide to *these*. He lays out his money uselessly in purchasing many guides, and throws away his time in perusing them to acquire a knowledge of the favourite objects which he desires to examine. They say little about them, and he is obliged to make some sort of a guide for himself, by carefully looking over the official catalogue, which, after all, is the best popular guide. He then finds he can go armed with all strength to see what he wants to see. He has found, like when he studied mathematics, that he cannot be hurled along with a class, or even lead it. He is best by himself, do what little he may. He understands things better, for the simple reason, that he meets them prepared so to understand. In the pursuit of knowledge, he not so much acquires it as it volunteers companionship with him.

Now, if we read the history of all learning with but a little care, we shall find that it progresses precisely in this way, or not at all. That this course is indispensable to its life. That infancy, childhood, youth, and manhood, must precede age. Before we can understand, we must place ourselves in a position to understand. We must, in the common-sense phrase of common language, *feel* our way. If we do not, we fall or stumble. The Great Exhibition may, for our present purpose, be said to contain four great classes of objects—(1.) Examples of brilliant physical demonstrations of mathematical truths. (2.) Examples of contrivance. (3.) Examples of the embodiment of taste. (4.) Examples of things which appear in all their perfection at first sight as well to the "educated" as the "uneducated." Many of the objects are compounds of two or more of these classes. Our readers will not require instances. Perhaps we have accidentally put these classes down in the order in which they ought to stand—the most worshipful first. The popularity of each, in this order, might be expressed by the progressive numbers, 1, 10, 1,000, 10,000. Where ten thousand were attracted by, and pleased with those things which explain themselves, and the sight is considered popular, there it would also be popular if but one person luxuriated in the wonder displayed by the highest order of mind. What place the fine lady or the fine gentleman above referred to would hold it is not for us to say; but it is readily perceived, that the genuine popularity of the Exhibition would gain nothing from their presence. They could be expected only to be pleased as the ten thousand are pleased, or as the thousand or ten say they ought to be pleased, which is all one and the same to them. When, however, we see the ten thousand giving unmistakeable evidence of profitable interest in the other classes of objects—when we see not one, but thousands of the shilling visitors determined to carry away with them many ideas for every farthing, and recur again and again to the grand depository to fill up uneasy voids, then are we compelled to admit the real popularity of the scheme, and even the moral grandeur of the very popularity itself.

Another exhibition of the kind some ten years hence will, it may be imagined, be productive of many important as well as interesting results, from the quiet scrutinies which have thus gone on into the modes of human industry. This has been the first little lesson placed before the people to learn, and how well they have learned it, it will be for them, in the coming time, to show. All we can say is, that we wish them God speed.

PROGRESS OF SHIP-BUILDING.

ROOF OVER BUILDING-SLIPS AT ST. PETER'S DOCKYARD, NEWCASTLE.

(*Illustrated by Plates* 78 *and* 79.)

During the last war, the attention of Government was forcibly directed to the vital importance of building vessels under cover, by the alarming ravages of the dry-rot throughout the fleet. The consequence of this has been, that several very large roofs have latterly been erected over the building-slips of some of the Royal dockyards to check the evil, by protecting the exposed timbers from the injurious effects of moisture.

In a climate so uncertain and changeable as ours—where we have to encounter such sudden alternations of heat and cold, humidity and dryness—it is astonishing to find that private ship-builders have done so little to secure their work from its influence. It might be presumed that the great advantages of uninterrupted progress in the construction of their ships, and the certainty of a higher classification at *Lloyds*, would be sufficient inducements to commercial builders to adopt what is so evident an improvement. So far, a roofed slip is almost unknown amongst them, but they are gradually awakening to a sense of its value, and the system promises soon to become general.

The most recent and complete example of this class of roof is that now erecting at Messrs. T. & W. Smith's, St. Peter's Dockyard, at Newcastle, from the designs and under the superintendence of Messrs. R. B. Bell & D. Miller of Glasgow. Of this roof we this month present two illustrations. Plate 78 is a longitudinal elevation of a portion of the roof, with its windows and supporting pillars complete; and plate 79 is a corresponding transverse section. The roof is double, to cover two separate slips; and a new feature has been introduced into them, in the adoption of overhead travelling-cranes—involving a construction totally different to the structures in the Government dockyards. These cranes have both a longitudinal and a transverse motion, so that they can take up loads from any corner of the building, and thus very materially diminish the expenditure of manual labour.

The two roofs are so placed that the central range of standards forms the support for both. They are unequal in size, the larger being 61 feet 6 inches span from centre to centre of the standards, and 247 feet in length; whilst the other is 55 feet 6 inches span, both being of the same length. The timber standards support the roof at a height of 45 feet above the ground, and curved wing-roofs project 12 feet 9 inches on each side, making the combined breadth of the two roofs 145 feet.

The details of construction of the roofs are given very clearly in the transverse section, plate 79. Each principal is made of a combination of cast and malleable iron, forming a girder of the kind technically known as the "bow and string principle." The bow, which is of an elliptical arched form, slightly pointed in the centre, is made of Mr. Morries Stirling's "toughened cast-iron," and consists of a broad thin web of metal, with flanges on the top and bottom. It is very deep at the springing, and diminishes gradually as it approaches the centre, but being slightly increased at the culminating point. The springing is cast in such a manner as to embrace the top of the standards, and thus prevent or mitigate any oscillatory motion. At a distance of 4 feet 10 inches above the springing, wrought iron tie-rods connect the two extremities of the bow, being attached by cotters passing through eyes cast on the bow. A king-rod from the crown of the bow supports the main tie-rod in the centre, and on each side of it diagonal ties resist any lateral pressure which may come upon the roof. The tie-rods being thus elevated, sufficient head-room is afforded to allow the men to work on the travelling cranes, whilst the peculiarity in the shape of the roof presents a powerful resistance to the crushing force, arising from the presence of the great weights which require to be lifted. Snugs are cast on the outer flange of the bow, for bolting the purlins which stretch from end to end continuously, and bind every part of the roof together. Upon the purlins is fastened the sarking, or cleading, covered with sheet zinc.

The girders, or principals, are placed 15 feet apart, resting on the top of the massive timber standards, to which they are firmly bolted. These standards are 50 feet in length, and, to obtain greater lateral strength, are made double, by sawing up logs of Baltic timber, the two halves being set 15 inches apart by intervening blocks of wood, and bolted together transversely. They are sunk 5 feet into the ground, and rest on large stone bases, embedded in concrete, the sunk portions of the timber being creosoted to preserve them from decay. A strong system of trussing, stretching along on each side of the structure, throughout its whole length, connects the heads of the standards together. In this way great rigidity is secured, and a support is furnished for the travelling-crane, which is carried on rails on a longitudinal beam, placed on timber, and cast-iron brackets projecting from the standards and trussing. An immense quantity of glass is used in the erection, the object being to afford complete protection from the weather, whilst, at the same time, the supply of light shall enable all operations to be carried on with as much facility as in the open air. The glazing extends along the whole roof continuously from end to end, 18 feet in breadth at the ridge, and having a strip on each side farther down towards the eaves, of 5 feet wide, making an aggregate breadth of glazing in the two roofs of 56 feet. In addition to this, the entire sides, above the wing-roofs, are completely glazed, as are also the gables at each end. The glass for the roof is plate, of 22 ounces to the square foot; that for the sides and ends is of a lighter kind, being only 16 ounces per foot, or the same as that used in the Great Exhibition building. The whole quantity of glass amounts to 15,000 square feet.

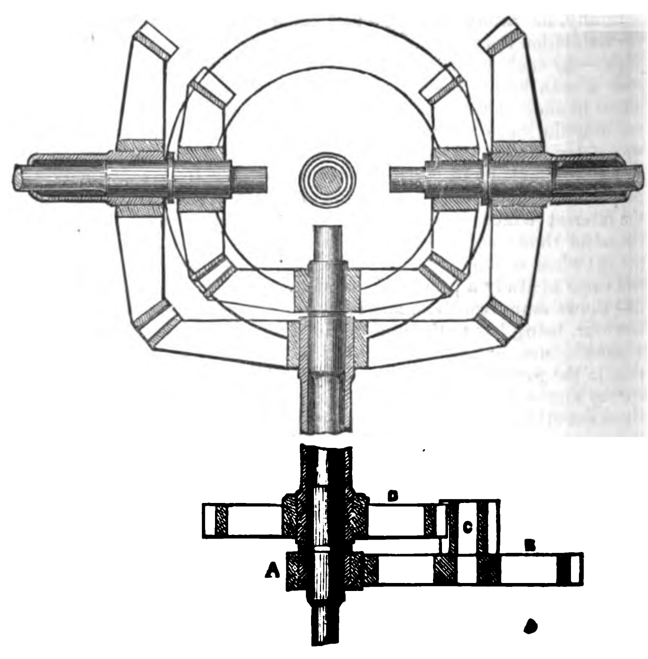
The intense competition which our ship-builders have now to encounter from abroad, is beginning to act as a powerful stimulant in directing attention to the best means of rendering mechanical appliances more available in this branch of engineering construction, and so bringing about greater economy and better workmanship in the production of ships. Viewing their position in this light, the eminent builders, whose roof we have just described, have made other large additions to the machinery of building, in the way of steam-engines, saw-mills, steam-cranes, and lines of railway for conveying and working their timber. The whole of these works, under the superintendence of Messrs. Bell & Miller, are rapidly approaching completion, and promise to supply an excellent example of a judicious application of mechanism in a comparatively new direction.

NOTES ON THE GREAT EXHIBITION.

BLAYLOCK'S GEARING FOR TURRET-CLOCKS—FRODSHAM'S IMPROVED WATCHES—HALL'S ASTRONOMICAL AND METEOROLOGICAL CLOCK—HUGHES' TYPOGRAPH—FOUCALT'S PRINTING KEY FRAME.

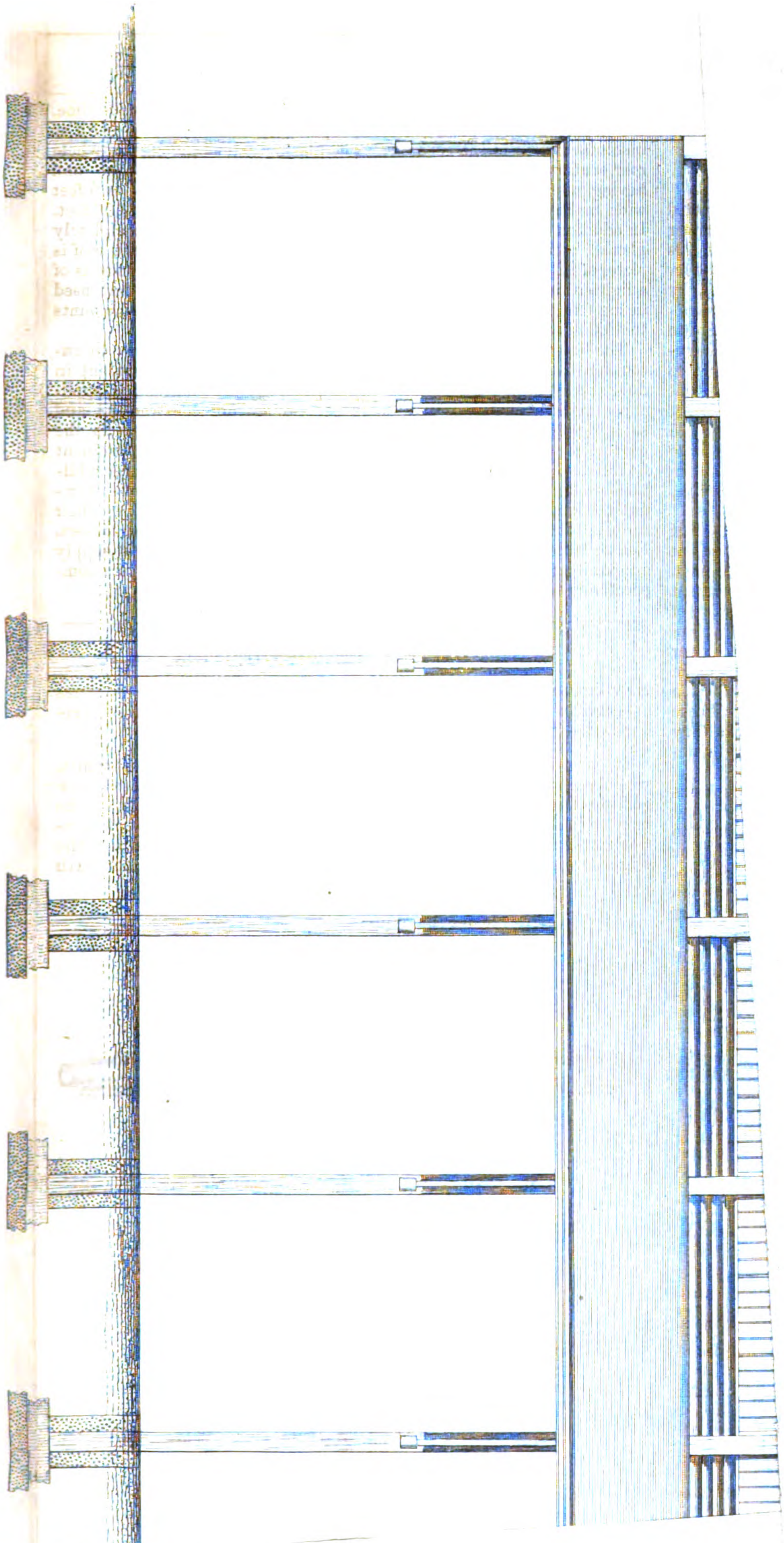
In our previous remarks on Mr. Blaylock's horological improvements, we only described his self-regulating gas illumination for dials; we now add his other contributions in the shape of a movement for driving the hour and minute hands of a turret clock with four dials. Our illustration furnishes an elevation of the movement, one-fourth the size of the original, which the reader will find in Class 10, No. 93, in the south

Fig. 1.



1-4th.

gallery near the large organ. It will be seen that in both sets of bevel wheels, the driving wheel must be a little larger than the four driven ones, so that the latter may clear each other. In our fig. 1, they are delineated in the proportion of 6 to 5. If the arbor in the clock movement revolves, as is usually the case, exactly in an hour, either of the



pairs of bevel wheels may be employed for connecting the arbor with the upright shaft—the larger wheel of the pair being keyed on the foot of the upright shaft. The four minute-hands will then evidently move at the same speed as the arbor in the clock movement, and if the product of the quotients of the pinion, A, divided into the wheel, B, and of the pinion, C, into the wheel, D, is equal to 12, it is also evident that the four hour-hands will move at the proper rate. The apparatus is simple, and more compact than any other we have seen.

Amongst other examples of horological mechanics, Mr. Charles Frodsham, the eminent chronometer-maker, exhibits a specimen of a marine chronometer on a new calibre, with Arnold and Earnshaw's detached escapement, and compensation balance of the ordinary kind, but with Arnold's bar as auxiliary compensation. This new calibre is based upon the diameter of the barrel, the fuzee wheel and extreme diameter of the balance being the same, or 1 inch and 5-10ths. The total weight of the compensation balance is 5 dwts., or as the contents of the barrel; that is, if a barrel 1 inch in diameter and 3-10ths deep, will carry a balance weighing 20 grains, a barrel of the same diameter, and thrice the depth, will take a balance of 40 grains. The balance spring is 15 inches long; the diameter is $\frac{45}{100}$, the thickness of wire being $\frac{10}{1000}$ by $\frac{18}{1000}$ broad, and the number of the turns 10 to 12. The wheels, including also the 'scape wheel, are each five times the diameter of their respective pinions. The fuzee wheel has 90 teeth; the centre wheel, 90; centre pinion, 14; third wheel, 80; third pinion, 12; fourth wheel, 80; fourth pinion, 10; 'scape pinion, 10; 'scape wheel, 15. He also shows a "double rotatory escapement," on a new calibre movement, by which a powerful watch may be made in a flat case. Mr. Frodsham is of opinion that this form ought to have been introduced at the time flat watches were first introduced, as it possesses all the advantages of a thick watch. Another of his contributions is a "gold lever watch, with split-centre seconds-hand movement." By this time-keeper, the observer may determine the precise time of any observation to the nicety of a quarter of a second. For this end, it has an extra seconds-hand, which, in the ordinary state of the watch, lies beneath the principal seconds-hand, and travels with it. In taking an observation, the operator, keeping his eye steadily on the object, has his finger in readiness to touch a spring, allowing the registering hand to fall at once upon the face of the watch, where it may remain 40 seconds for reading off the time. This done, the finger is to be removed to free the register, which at once returns to its place in readiness for the succeeding observation; the correct performance of the watch not having been interfered with in the slightest degree.

Mr. G. F. Hall, of Norfolk Street, Fitzroy Square, the inventor of a variety of ingenuities in philosophical instruments, has an improved astronomical and meteorological clock, intended "to give a more correct measure of mean time, and to register the mean hourly variation of the barometer and thermometer in permanent lines of variable length." There are few results of the scientific investigations of the present age, that are looked upon with more interest than that of the automatic registration of meteorological apparatus, when accomplished successfully; such as the daily and monthly periodical variation of the barometer, the thermometer, the horizontal and vertical force magnet, and electrical state of the atmosphere. Early in the last century, it was thought necessary to record and tabulate the various atmospheric changes, so as to render the invention of the barometer and thermometer of that interest and utility that it was found by these means to possess. Scientific men, therefore, undertook, in different parts of Europe, to record, at stated times, the variation of the then series of meteorological apparatus; but though often attempted, and for a certain length of time performed, the troublesome and irksome task was soon abandoned, to be again undertaken with the same result by younger or more enthusiastic aspirants in the school of science. In the meantime, mechanical philosophy made rapid strides, and that which was abandoned as of impossible accomplishment by the men of one generation, was found easy of fulfilment by the more cultivated intellect of the next. Then it was that the more ponderable attributes of meteorology, such as the force of the wind and its direction, and the quantity of rain that fell at any given time, were soon faithfully recorded by mechanical means. Not so, however, with those more delicate instruments, the barometer, thermometer, and the variable force of magnetism. These, from the days of CAVENDISH and PRIESTLY, have, until very lately, mocked the efforts and powers of invention of the most scientific men of the past and present age; and it is only by employing that delicate and subtile agency, light, in its action on photographically-prepared paper, that any continuous registration has been effected. This, from expense and delicate manipulation, has a considerable drawback. That the means, however, of fully accomplishing so desirable an object, have been within the reach of scientific investigators from the days of Torricelli to our own, we will presently demonstrate; the whole of the effects we shall presently describe being accomplished by clockwork, or horology—a science known long before the invention of the barometer, the first and principal of meteorological apparatus. And not only is the registration accomplished which has been for so long a time a meteorological desideratum, but a new field of investigation has been opened, in which men of science may gather fresh truths for more than another century. We allude to the registration of meteorological phenomena *at a distance*, or from the *tops of mountains*, effected by the present invention, from which we may investigate the action of certain clouds upon the barometer, the non-effect of others, and carry our observations and our instruments above the height of those very clouds, which have so long baffled the powers of the most scientific men to afford a satisfactory explanation.

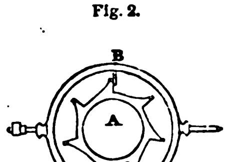
If a rod of wood be taken, and vertically suspended from about the middle, and a weight, or bob, similar to that of a pendulum, be affixed to the lower end thereof, it will be found that, upon making it vibrate, its vibrations will be slower in proportion to the increase of weight that may be affixed to the other end, or upper half of the rod, and that very small weights will cause a considerable variation in the number of vibrations per hour; such difference being caused by the variation in the radius of gyration. This property of the *gyrator* has been for some time in use in the *metronome*, an instrument used in music to indicate the time in which any piece of music is to be performed,—the weight in this instance being raised to a greater distance from the lower weight, or bob, in preference to the increase of the weight. If we now apply the foregoing principles to the barometer, suspended and made to vibrate continually on knife-edges from about the centre, we shall find that, for every small variation in the rise or fall of the mercury in the barometer, we shall have a corresponding difference in the number of vibrations made by the suspended barometer, in any fixed period of time, or per hour, caused by the variation in its radius of gyration; hence its name, *gyrator*. The same effect is caused in the thermometer by expansion, whether applied to air, spirit, or mercury.

It will now be evident, that if we apply a make and break contact, we may, by electro-magnetism and the galvanic battery, keep the vibratory motion up for any length of time, and also register the number of vibrations per hour, and from that deduce simply the variation or height of the mercury in the tube. Thermometric variations can also be thus recorded, as well as the variation in the vertical and horizontal force magnets. In recording the variations in magnetical force, the time of vibration is of course affected by the intensity of the magnetic current; this, from the time of Mr. Coulomb, has been found to be by far the most delicate test by which almost all magnetical experiments have been determined. Yet the simple addition of a train of wheels and escapement, to make the vibration continuous, and to register the variations therefrom, have never, until the present instance, been even suggested.

Mr. Hall's inventions will be found in Class X., No. 60, and may be here described with the assistance of the three figures annexed.

The annexed diagram, fig. 2, represents the 'scapement of the clock, which is of a new vertical dead-beat sound, with invariable force impulse pallets, the angle of repose of which is upon the teeth of the escape wheel, until the impulse is required. The reaction of the escapement is on a point instead of two bearings, as usual. A, Is a vertical wheel of seven teeth, which move in a horizontal plane. B, Is a concentric circle with two ruby pins, moving in a vertical plane. If the pins are circular or chamfered, the action is dead during the coincidence of the two planes; but as the pins vibrate, the top of the teeth of the wheel, A, slide under the circular or chamfered surface of the ruby pins, and give the necessary impulse to the pendulum.

Fig. 2.



The micrometrical adjustment of the pendulum for temperature is effected by a compound rod of brass and zinc, in the proportion of 20 brass and 10 zinc, joined just above the bob. A zinc screw is soldered into the top of the brass tube, and a steel screw into the zinc cylinder, both of the same pitch. The length of compensating-rod is first obtained by calculation; then, if the pendulum is compensated *plus*, the rod is turned to the right, which shortens the zinc screw and increases the steel one; the difference between the expansion of zinc and steel is the amount rendered *minus* in the compensation. If the pendulum is compensated *minus*, the rod is turned to the left, which increases the zinc and shortens the steel; the difference between the expansion of the two metals is the amount or quantity rendered *plus*. The pendulum is made of two glass tubes expanding downwards, and the compensating rod expanding upwards—the bob being placed upon studs fastened to the inner glass tube, and passing through the outer one. The black line in the drawing is the compensating rod. The pendulum, fig. 3, has two glass rods, the inner one of which carries the

bob, and the outer one the compound compensating bar, in which two metals of great difference of expansion are used, each having a screw of the same pitch at its extremity. This arrangement affords what may be named a micrometrical adjustment for temperature. The accompanying elevation of the clock, fig. 4, shows the meteorological attachment: A a, are two revolving cylinders, fastened to the arbors of the first wheels of the train, and which revolve (upon the average) once in three hours; B b, are the escape-

Fig. 4.

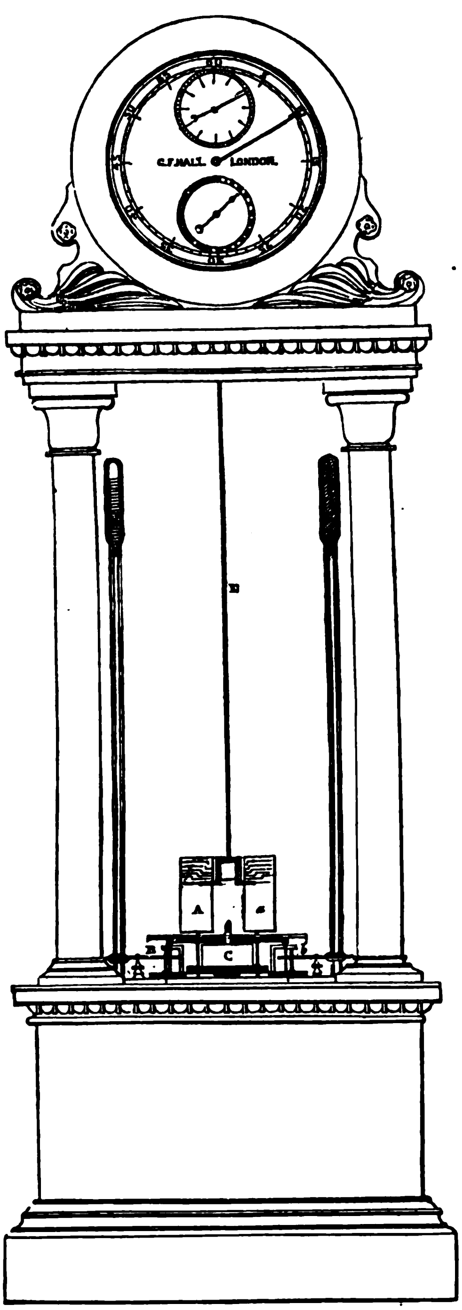
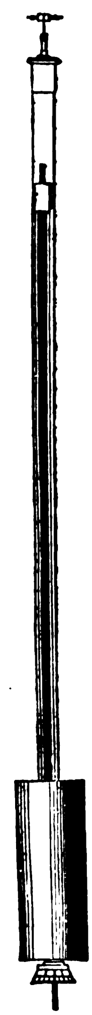


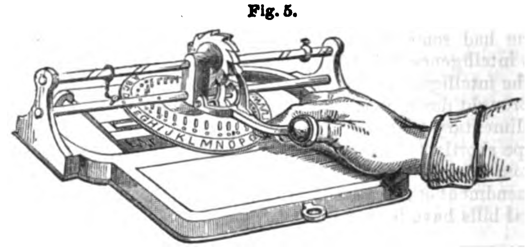
Fig. 3.



wheels of the train, of the same kind as the clock (the vertical dead-beat), of twenty-five teeth; C, is the going barrel, to impel the two independent trains; D d, the thermometer and barometer; E, is the rod, to which is fixed the marking apparatus in connection with the revolving cylinder, A a. The action of this novel arrangement is as follows: D d, the thermometer and barometer, are made to vibrate continually by the escapement, B b, as inverted pendulums or gyrators, the radii of the gyrations of which are continually affected either by the pressure of the atmosphere, or by change in temperature; thus, *d*, the Torricellian barometer, will, if the mercury fall one inch, increase the number of its vibrations by 1.000 per hour, every one of which is registered on the revolving cylinder, A. The hourly measure in time is made by breaking the lines, caused by the marking apparatus descending one-twentieth of an inch. The baro-gymeter, *d* (barometer), and the thermo-gymeter, D (thermometer), though attached to the gyrometer, C, in the present instance, may, if required, be detached and placed at any distance, even to that of a thousand miles from the gyrometer or place of observation, and still the variation in the barometer, to a far greater nicety than by actual observation, will be transmitted and permanently registered, the electric wire being the means of communication.

Mr. Hughes, the excellent governor of Henshaw's Blind Asylum at Manchester, contributes a valuable assistant for the blind, in a portable "Typograph," or writing machine, fit for the use of the members of that unfortunate class, who are so dependent on their sense of touch. By its use, any one who can read the ordinary embossed Roman characters,

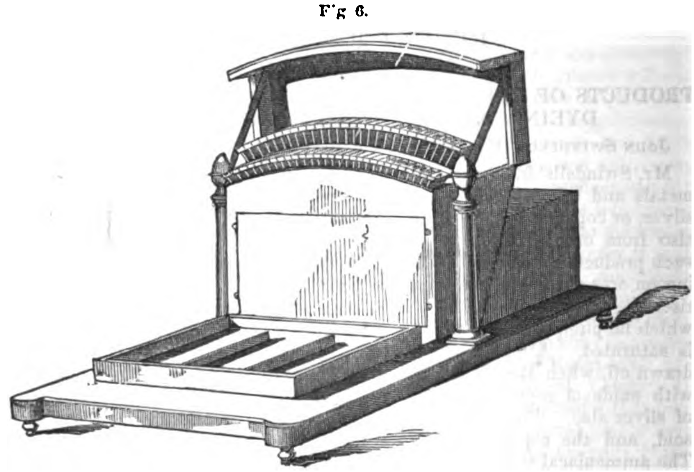
Fig. 5.



even of double the usual size, may communicate by letter, after a few minutes' instruction. It is contrived to give, at pleasure, any letter or figure in the eighth of an inch; and, if necessary, the blind writer may put with ease 64 distinct letters within the space of a square inch. Its services are not, however, confined to mere writing, as it is capable of being turned to valuable account for printing uniform labels for museums, and cabinets of specimens, which require naming. Our engraving, fig. 5, shows the little apparatus in perspective. In a recent perambulation through the Exhibition, Her Majesty paid especial notice to Mr. Hughes' invention, and spent some time in witnessing the performances of a blind girl upon it.

Another instrument of a like nature is to be found in the French department. It is the invention of M. Foucalt, himself a blind man, and formerly a pupil in the Institution for the Blind in Paris. Our engraving, fig. 6, represents the apparatus as open for use. The alphabetical characters, constructed in relief, on a large scale, are each attached to the

Fig. 6.



upper end of a metallic rod, made to slide in a corresponding groove, the lower end of each rod having the corresponding letter on a small scale, for giving the impression in ink to the paper beneath. The characters, disposed in two arched rows, are arranged so that they shall all comerge to one centre. As each letter is pressed by the finger of the blind printer, it gives its impression on tracing paper, the same movement again bringing forward a clear surface of paper for the succeeding impression. As each line is printed, the paper is moved perpendicularly for a new one. A modification of this instrument was first shown at the Parisian Exposition in 1849, when M. Foucalt was awarded a gold medal for the invention, and, in 1850, the Board of Encouragement in Paris further rewarded him with a second gold medal. The cost of the instrument is stated to be £20.

THE PATENT LAWS.

The Session of Parliament is at length over; and amongst the batch of bills usually smothered at the termination of each session, we this year find "Patent Law Amendment Bill, No. 3."

From our remarks last month, our readers will have gathered that we do not join with many of our contemporaries in deploring the untimely fate of the bill; it was altogether too crude a measure to hold out much prospect of being satisfactorily worked.

The House of Commons made some very material alterations in the bill in committee; the clause excluding the colonies from letters patent was struck out, and the commissioners were restricted in their inquiries, to the novelty of the invention, the word "utility" being given up, upon the motion of Mr. Ricardo

Many of our weekly contemporaries were so convinced that the bill would pass, that they announced that it had passed; and to some of them, who had some time previously announced, upon "certain and exclusive intelligence," that the bill would certainly become a law this session, the intelligence of its defeat in the Lords was highly annoying, and has brought down upon that house expressions of opinion anything but complimentary to its members.

We hope shortly to be able to give a review of the several measures which, from time to time, within the last few years, have been proposed for the amendment of this branch of the law, and the evidence upon which the several bills have been framed.

MECHANIC'S LIBRARY.

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RECENT PATENTS.

PRODUCTS OF ORES FOR BLEACHING, PRINTING, DYEING, AND COLOUR-MAKING.

John Swindells, *Manchester*.—*Enrolled May* 14, 1851.

Mr. Swindells' invention has reference to the obtainment of metals and other products from ores containing copper and silver, or copper only; from ores containing chromium, and also from ores containing zinc; and to the application of such products to purposes indicated by the title. In operating on ores of copper or silver, the patentee first desulphurises the ore, and then places it in water-tight tanks, into which he pumps a weak solution of ammonia until the ore is saturated. After standing several hours, the liquid is drawn off, when the ammonia will be found to be saturated with oxide of copper, and if silver is present, with oxide of silver also. The silver he precipitates by hydrochloric acid, and the copper afterwards by hydrosulphuric acid. The ammoniacal solution used is of a strength of 0·980°.

With zinc ores, the material, as native sulphuret of zinc, is mixed with about its own weight of common salt, and calcined in an oxidizing flame, to convert the sulphur into sulphuric acid, when the products are separated by dissolving the soluble portions in water, first obtaining the sulphate of soda, and afterwards precipitating the metallic oxides of zinc and iron by means of lime.

The ores of chromium are pulverised, and mixed with common salt; and to obtain a product containing soda as the alkali, the mixture is exposed in a reverberatory furnace to a full red heat, applying at the same time a jet of high-pressure steam. The product of this process is chromate of soda, the hydrochloric acid having carried away the iron. The product withdrawn from the furnace is treated as in the manufacture of chromic or bichromic salts. The patentee proceeds in a similar way with the potash salt, and the lime mixtures. From the first he manufactures pure bichromate of soda, and, by adding hydrochloric acid, procures chlorochromate of soda; and from the last, he makes chromate of lime, or, by the addition of soda or potash, a compound salt of soda, or potash and lime.

REGISTERED DESIGNS.

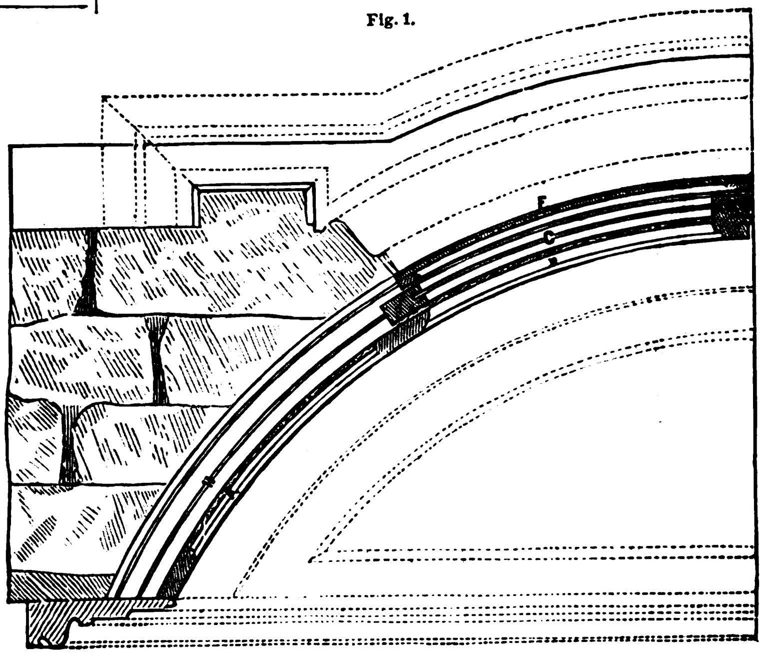
THE ALBERT WINDOW.

Registered for Isaac Farrell, Esq., *Architect, Dublin.*

Whilst modern improvement has done much for most of the details of buildings, the window appears to have been quite overlooked, and is burdened with many objections and inconveniences which ought to have been long since cleared away; we have had to choose, so far, between the ordinary sash, with its lines, pulleys, and weights, or the French window, opening on hinges. The first, bearing the indelibly ugly mark of junction of the two sashes in the centre, whilst only one half can be opened; and the second, a vital difficulty in being made air-tight, and, when open, a constant risk of fracture. Of the two, the French plan possesses the balance of advantages; but we suspect it is a greater favourite in summer than in winter.

In Mr. Farrell's "Albert window," the disadvantages of both are sought to be removed. It is circular on plan, forming a panelled circular recess on the inside, so contrived that the sashes form a portion of the panelling; and whether open or shut, the uniformity of the design remains undisturbed, and the panelling still perfect. The reveals are splayed to the radiating line of the circle, so as to admit the greatest quantity of light, and allow an extended prospect; to the latter, the slightly-bowed form of the sash greatly contributes, while it adds considerably to the external effect; but the great object attained by the circular configuration is, that it permits of the sashes and shutters being moved horizontally on curved rails, so as to run back on each side, and be concealed when open behind the jamb-lining of the window. The circular plan alone admits of this convenience, without reducing the strength of the walls by forming recesses to receive the sashes, nor is it necessary to increase the width of the open, beyond what is required for the boxings of the shutters of an ordinary window of the same size. By this form, and the contrivances dependent thereon, the sashes are rendered perfectly weather-proof; and the appliance of outside safety-shutters of the cheapest construction (being a plate of sheet-iron, in a light frame, with friction-rollers at top and bottom), and of the greatest strength, becomes a simple and easy operation

Fig. 1.

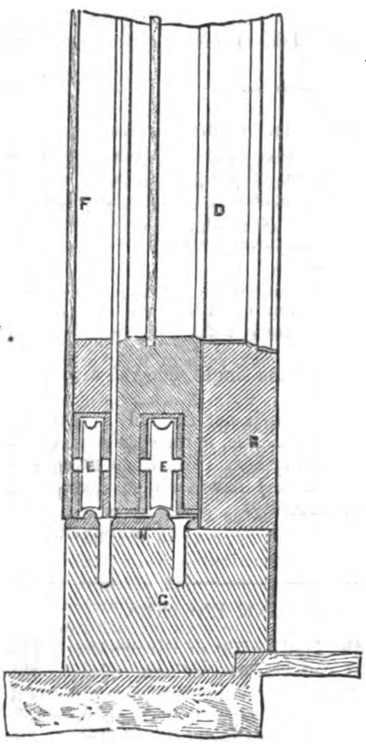


1-12th.

Our engraving, fig. 1, represents a sectional half plan of the window; fig. 2 is a transverse vertical section of the portion next the ground, showing the traversing pulleys—this figure being on a larger scale.

The panelled jambs, A A, are framed to the circular form, their top and bottom rails, B B, are continued across the open in the same curve, so as to connect them, and form one piece of circular framing with an open panel in the centre; this piece of framing forms the lining of the window, and is firmly secured to the strong fixed head and sill, G G.

Fig. 2.



1-4th.

The sashes, C C, are made to fit to and play against the outside of the above circular framing, their margin being coincident with and overlapping that of the centre open panel all round, so as to afford the utmost security against the weather; the centre or meeting stiles of these sashes, D D, are increased in thickness, so that their inside face becomes fair with that of the fixed framing; they are scribed or fitted at top and bottom to the rails, B B, of the said framing, which they travel over when moved; by this contrivance great stiffness is obtained for the sash, and a deeper and more perfect vertical joint, while the obstruction to the light is the least possible, and a uniform surface is preserved in the inside framing. The sashes are glazed with bent glass, and run on friction-rollers, E E, inserted in the head and sill, so as to give them a parallel motion.

The shutters, F F, are of sheet-iron, as before described, bent to a curve concentric with the sashes; they also run on friction-rollers, E E, inserted in the top and bottom; both sashes and shutters run on circular metal rails, H H, screwed on to the strong fixed head and sill, G G. These rails are coincident with the curve of the sashes and safety-shutters, and are continued all round the segment from architrave to architrave, so that, on the sashes or shutters being opened, they are carried round on each side from the centre, and are lodged in the cases provided for them at the back of the jamb-lining, A A.

The exterior and interior views of the window are both very beautiful, as may be seen from the half-size model in the Exhibition.

VENTILATING CHIMNEY-TOP.

Registered for MESSRS. N. STEAD & SON, *Hulme, Manchester.*

Fig. 1

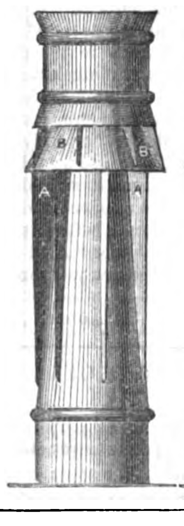
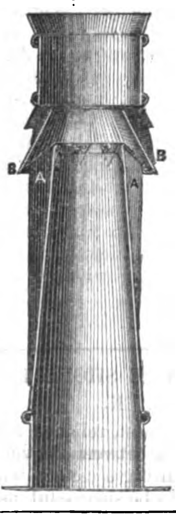


Fig. 2



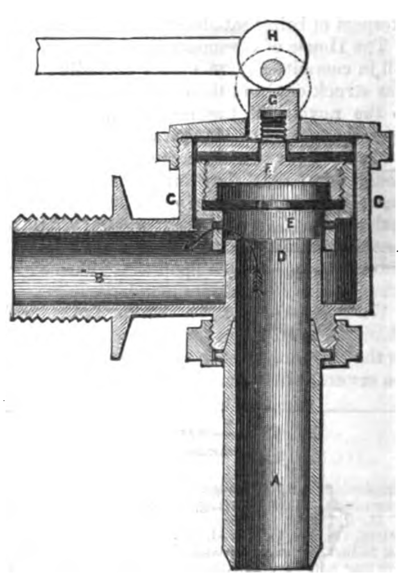
The novelty of Messrs. Stead's invention consists in forming the chimney-top with a double set of vents or wind-courses, as at A A and B B, by means of which a downward draught is effectually prevented. Should the wind blow down the mouth or top of the chimney, the upward draught through the vents, A, will counterbalance this action, and drive out the smoke by the other passages, B.

Our engravings represent, in fig. 1 an external elevation of the design, and in fig. 2 a vertical section.

ELASTIC DISC VALVE.

Registered for MR. W. KIRKWOOD, *Plumber, Edinburgh.*

This ingenious valve, of which our engraving is a vertical section, is intended as a supply-valve for water-closets, but is obviously applicable in various other situations. The water enters by the pipe, A, and passes off by the horizontal side branch, B. The shell, C, of the valve is cylindrical, and is bored out true, with a short concentric length of pipe, D, cast upon, and standing up from, its bottom, the supply-pipe, A, being screwed on in a line with this pipe. The elastic disc, or leather washer, forming the closing apparatus of the valve, is at E, being secured between the two portions of the tubular piston, F, the lower end of which fits loosely over the top of the piece of pipe, D. This piston works water-tight within the shell, by means of a second washer of felt, held down on the top of the piston by a metal disc above, which is secured by a screw-cap, G, passing through the cover of the valve.



In our sketch, the valve is shown open, the leather washer, E, being elevated above the top of the open-ended pipe, D, so that the water flows through the ring of apertures in the lower portion of the piston, as indicated by the arrow. When it is to be closed, the eccentric lever, H, is turned over to the opposite side, to the position of the dotted circle, when it acts on the top of the cap, G, and presses the disc, E, down on the top of the pipe beneath. The water entering by the central aperture in the disc, fills the cavity above it in the piston, and presses down the disc on its face, making a tight joint for the time being. Another portion of the design refers to water-closet apparatus, which consists of a strong, external, cylindrical case of coarse earthenware, with a white glazed porcelain basin placed within it from below, the lower neck being jointed on to the earthenware discharge-pipe. The space between the outside of the basin and the external case is filled up with Roman cement, making the whole one substantial mass. This makes it a strong substantial apparatus, and dispenses with the ordinary expensive timber framing.

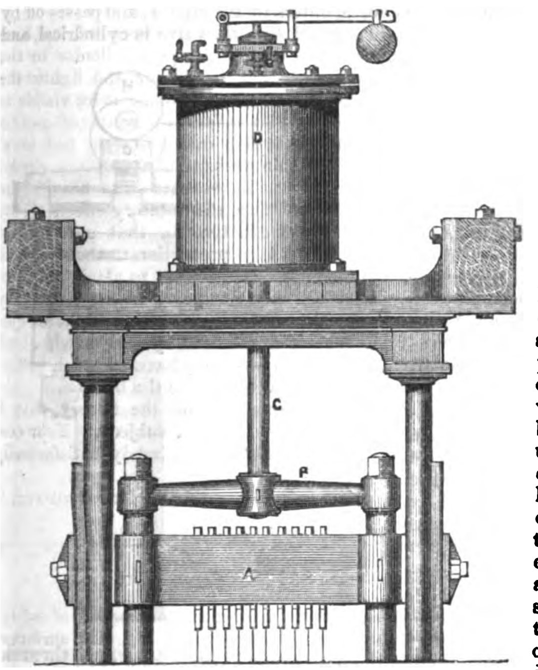
CORRESPONDENCE.

ATMOSPHERIC BALANCE FOR SAW-FRAMES.

The improvements recently effected in the department of machinery in use for cutting and preparing timber, are such as to give to this particular branch of mechanism an importance which is only now beginning to be felt and appreciated. My object in now addressing you, is to furnish a small addition to these improvements, as I shall now proceed to explain.

I would first remark, that the ordinary mode of balancing saw-frames is very objectionable, an opinion in which most observers will probably agree when they remember, that there is a dead weight of material of 30 or 40 cwt. performing a reciprocating action at the rate of 500 or 600 feet per minute, with a counterbalance of 10 or 12 cwt. fixed to the rim of a fly-wheel, which has a velocity of 50 feet per second. It must be very clear, that great difficulty will be experienced in getting the building or frame-work carrying the crank-shaft to stand the successive jerking strains to which it is constantly subjected. The greater the gross weight of the working frame, of course the greater the difficulty of balancing it. In earlier days, the inconvenience was little felt, inasmuch as the machinery was then comparatively light, whilst the velocity was only half what it now is. A few years ago, it occurred to me that a vacuum cylinder might be judiciously applied for the balancing action, and the practical test of the plan has given a very satisfactory result. By adopting this system we get rid of all counterbalance weights, and very greatly reduce the friction of the working parts; in fact, it may be

said that the crank-pin is entirely released from the weight of the frame, which is, as it were, poised on the atmosphere in both up and down strokes. The annexed figure exemplifies one form of application of the cylinder. A, Is the upper part of the saw-frame, driven from below, B being an extra crosshead, to which is attached the piston-rod, C, working in the cylinder, D. The cylinder is bolted down in an inverted position, upon four elevated corner blocks, cast upon the entablature, leaving four openings between the entablature and the square bottom-flange of the cylinder, to allow the atmospheric pressure to act on the lower side of the piston. The upper end of the cylinder has an air-tight cover, in the centre of which is a conical valve of large area, the lever of which is so loaded that any small quantity of condensed air that may lodge between the piston and cover, at the termination of the up-stroke, may be discharged without any perceptible lift of the valve. Two small nose-cocks are placed on the cover, to allow of an occasional supply of melted tallow to the interior of the cylinder. An additional cock is also shown as adapted for tempering the vacuum, that is, for vitiating it more or less, as any overplus of cylinder area may render necessary; but the nearer the area of the cylinder is made to approximate to the weight of the saw-frame, in order that it may work without any opening of the cock, so much the better, as it prevents any unnecessary discharge of air through the valve. The piston is similar to that used in steam cylinders, but somewhat lighter, and fitted with metallic packing-rings. To ascertain the area of cylinder required to balance a given weight of frame, the extent of vacuum may be generally assumed at 9 lbs. per square inch. Before starting the apparatus, the frame is raised to its top centre, by hand-gearing working into a toothed portion of the periphery of the fly-wheel, the pinion gearing into which is disengaged previous to throwing the driving-belt on to the fast pulley. When the frame is in motion, there is, to a certain extent, a continuous vacuum in the cylinder, between the piston and the top cover, and to leave as little room as possible for the accumulation of air at the end of the up-stroke, there is merely a sufficient allowance for clearance. This mode of balancing may also be applied to saw-frames worked by side-rods; or, when a frame is driven from the top by a central connecting-rod, two cylinders having a joint area of the required extent may be fitted to work clear below the crank shaft.



JAMES NEIL.

Glasgow, August, 1851.

DOUBLE-EXPANSION STEAM-ENGINE.

It appears by a letter from Mr. Morton, in your *Journal* for this month, that he is very considerably surprised at the appearance of my letter on the double-expansion steam-engine, and thinks I do not understand the principle of his plan of engine, or will not acknowledge the improvement involved in it. If you will allow me to surprise Mr. Morton a little more, by showing him that the misunderstanding as to the principle of the engine is on his side, I shall be much obliged.

The worst feature in Mr. Morton's engine is the application of the stuffing-box between the two pistons; and in this matter Mr. Morton has shown his ignorance of the principle. He says, in his letter, "My small piston and stuffing-box lose no steam at all, as the same temperature and pressure exists on each side"—not a very powerful engine, I think, if this is correct. This is, however, the case as regards the down-stroke of the engine; but on the up-stroke, the full pressure of the steam from the boiler is acting on this stuffing-box, and with a vacuum below, if the engine is good and tight. This is the time (and it takes place at every up-stroke) when the stuffing-box leaks, and destroys the vacuum in proportion to the leakage of steam; and, judging from its situation, I should say it is quite impossible to keep it tight any length of time.

At the termination of every down-stroke of the engine, the two cylinders are full of steam, which must be exhausted before making the up-stroke. There are, therefore, two cylinder-fulls of steam exhausted at every double stroke of the engine. Mr. Morton thinks he saves a good deal in the cost and friction of large cylinders; but, no doubt, has lost sight of the fact, that, by having the large cylinder four times the area of the small one, as in my engine, he would much more than compensate for the extra cost in carrying the economical principle of expansion of steam to a much greater extent.

Respecting the steam passing by the piston of steam-engines, this occurs only when the piston or cylinder, or both, are defective; and if allowed to continue with the steam generally used, very soon destroys the cylinder.

Many of my engines are working with the single slide-valve referred to by Mr. Morton.

I would beg to remark, that Mr. Morton is not the only inventor of the modification of the combined cylinder engine, in the way he proposes with the—as I term it—internal stuffing-box. The same thing has been named to me by many; but I believe I have, without exception, satisfied the whole that it is a great absurdity.

JAMES SIMS.

Redruth, August, 1851.

DOUBLE-EXPANSION TRUNK ENGINES.

Mr. Alexander Morton's objection to my suggested trunk engine are just; and it was an omission on my part in describing it, that I did not mention that it was intended entirely as a high-pressure non-condensing engine, under which conditions it would work without any great irregularity. The merit of the arrangement is solely simplicity in details; for the steam in it, or in any other engine expanding steam on the principle of Wolf's engine, is not so economically employed as in engines using a separate expansion-valve, on account of a part of the expanding steam in the large cylinder being employed in balancing the small piston. A portion of the area of the piston in the trunk engine is, therefore, useless in producing motion in the expanding stroke—namely, a surface equal to the area of the annulus. It is, however, noticeable, that the higher the expansion and consequent economy of steam is carried, the more regular will be the motion; and with an inverted engine on this plan, with areas on either side of the piston, in the proportion of 8 to 1, or thereabouts, the difference in the valve of the up and down strokes will be about compensated by the weight of the moving parts.

I presume your pages will contain a letter from Mr. Sims this month, in reply to Mr. Morton. Nevertheless, if I may be permitted to make a looker-on's remark upon their controversy, I would say that Mr. Morton's improvement, or alteration if you please, is only mechanical. He does not profess to produce a more powerful or economical engine; and, indeed, it is evident that the two plans are of identical value in these respects. There is, of course, friction in the intermediate stuffing-box; but, on the other hand, there is less in the diminished circumference of the larger piston. The friction of the piston-rod is, therefore, not "extra." The smaller advantages mentioned by Mr. Morton certainly exist; and while, it may be supposed, neither he nor any one else would deny that Mr. Sims has made a very neat and useful engine, it should be remembered that nothing of the kind was ever perfected at once; and I should not be surprised to see even Mr. Sims himself come before us ere long with something yet better than Morton, Sims, and poor "Aladdin," all put together. In expectation of which event, I leave you for the present.

August, 1851. ALADDIN.

COMMUNICATION WITH THE SHORE IN CASES OF SHIPWRECK.

Where shipwreck occurs along a coast, reliance must principally be placed upon effecting a communication between the vessel and the shore; this being usually accomplished by firing a cannon with a line attached to the shot. Now this cannot always be successful, as the range must

necessarily be limited by the calibre of the gun and the retarding weight of the rope. I therefore propose to meet the objection, by enabling the ship to send a rope to meet that fired from the shore. This may be done by fastening a grapnel to a float, with something to act as a small sail; and the wind necessarily being on shore, it would be floated in and driven ashore by the waves. To prevent the under-tow from carrying it seaward again, the anchor, or grapnel, must be attached in such a manner by catches, that when it reaches the land the float would be carried away, leaving the anchor on shore behind it, where it might be reached by a drag thrown from the hand across the rope; or the shot from the cannon might be fired across the rope from the ship, and the hooks attached to the ball would catch the rope and slide along it, until they were entangled in the way occurring with two persons cross-fishing, in uniting their lines by one throwing a stone with the line attached across the river in a slanting direction, and the other sending his line at right angles to it.

ALPHA.

August, 1851.

MORIN'S DYNAMOMETER.

As a constant reader of the *Practical Mechanic's Journal*, I shall feel greatly obliged if you can give a description, and, if possible, a drawing of a dynamometer, exhibited by General Poncelet, or Colonel Morin, I am not quite sure which. It is highly praised by the best judges, whose names would be a sufficient guarantee for their capability of giving an opinion, did I feel at liberty to publish them. There may be some notice of this instrument published in France, but I have not, as yet, been able to ascertain the fact, nor have I met with any person in the Exhibition able to explain the principle on which this dynamometer acts. I am sure an account of it will be useful to all who are interested in the application of mechanical science.

A CAPTAIN, R.N.

August, 1851.

[We have not seen the dynamometer to which "a Captain, R.N." alludes, nor have we met with it in the *official catalogue*. If our correspondent will refer to page 252 of the first volume of this Journal, he will there find an engraving of De Prony's dynamometer, a modification of which has been adopted by Morin, in his well-known frictional experiments. If he will give us some details of the apparatus in the Exhibition, we will endeavour to supply him with some information upon it, if it appears to contain anything more than will be found at the place to which we have referred him.—ED. P. M. JOURNAL.]

THE EARTH'S MOTION.

About three or four months ago, when Mons. Foucault's pendulum experiment was announced to us, it struck me that a preferable mode of exhibiting ocular proof of the earth's diurnal rotation might be obtained without much difficulty. My first idea was to support a long beam in a horizontal position, and by confining the friction chiefly to the lower end of the pivot of the supporting axle, a revolution of the beam was looked for; but the friction was found too great for so delicate an experiment. The next thought was to support a flat polished plate, or disc, on three anti-friction wheels, of about three or four inches diameter, their axles being nearly horizontal, and it was supposed that, if the beam were made to rest on the top of this disc, it would *seem* to revolve, by reason of the disc revolving with the earth, *actually* gliding round beneath it; still the friction was too great, and the disc carried the long beam round with it, making it seem stationary, and always pointing to the same part of the room. It then occurred to me, that the only method of securing success, and getting the ocular demonstration wanted, would be to employ a jar partly filled with mercury, and within this jar to place a smaller one, of the same form, empty—the beam, with weights at each end of it, being carried by this smaller jar, so that the load would be, in a great measure, borne off the wheels, and the friction almost annihilated. Instead of mercury, what was more easily come at was taken in lieu of it, namely, water, placed in a cylindrical vessel, about two feet deep, and fifteen or sixteen inches in diameter. Then a smaller vessel of the same form, about three inches less in depth, and three or four inches less in diameter, was placed within it, and the friction wheels were latterly dispensed with altogether. The arrangement, then, stands thus:—A piece of strong wire, No. 7 or No. 8, about two inches long, rises from the centre of the bottom of the outer vessel, and a bracket is attached to the middle of the under side of the bottom of the smaller vessel, with a perforation in the middle of the bracket to receive the wire. Then a cross, or, it may be, an entire disc, is fitted to the mouth of the smaller vessel, and having a very thick wire or rod passing up through its centre, for supporting what may be called our rocking-beam. A piece of sheet iron or brass, two or three inches diameter, with a hole in its centre to receive the upper wire or rod, and connected by four cords or wires with the mouth of the large outer vessel, completes the apparatus; and the instrument is ready for use when the inner vessel, with its upper rod, has been set, by means of the perforated plate and cords, perpendicular to the horizon. It might have been observed, that the longer and lighter the working beam the better, because the motion becomes more visible to the eye, and the further the observed point is from the centre of motion the better. For instance, a beam twenty-five or twenty-six feet long, will show a motion as visible as the minute-hand of a common clock; and another still more important point, the weights—the heavier the better—placed at the two ends for resisting the rotatory effects of the unavoidable friction of the centre, are effective for that purpose, not merely in proportion to their distance, but in proportion to the square of their distance from the centre of motion. Of course, to attain all these apparently incompatible ends, it becomes necessary to have the very light and slender beam crossed by three or more pieces at right angles to it, and the whole very firmly trussed and braced by cord or wire, both horizontally and vertically. The inner vessel may have as much ballast as it can carry without causing the bracket to graze the bottom.

So much has already been said in explanation of the theory, that it would be idle to waste a single word more on that subject. Your correspondents, Messrs. G. & W. M. Buchanan, have already satisfactorily accomplished this task.

J. B., DUNFERMLINE.

August, 1851.

DIFFERENTIAL SAFETY-VALVE.

Much has recently been said as to the improper construction of safety-valves, or the use of metals causing adhesion of the opening surfaces; but I am led to believe, that the fault arises entirely from the plan of the valve itself. What I propose as a substitute for the ordinary valve is a duplex valve, or one spindle with two valves fast upon it, one being a little larger than the other, and both of course opening the same way. This valve is to be so placed, that the steam from the boiler shall be introduced into the valve-chest between the two valves, so as to press on the top of the lower small valve, and against the underside of the higher and larger one. The effective upward pressure being greater than the downward, the valve must be kept closed down by a weight sufficient to balance the pressure required in the boiler, as exerted on the excess of area of the larger valve. When the boiler pressure exceeds that at which the valve is so set, it overcomes the weight on the upper valve, and of course opens both; but the moment the lower one is elevated from its seat, it loses all its normal counterpoising power, as the steam pressure is equal on both its sides. The pressure against the under side of the large valve, then, being no longer interfered with, both valves fly open, and at once relieve the boiler, giving a large area of steam-escape. By this arrangement, heavy weights and long levers are alike unnecessary, as the difference in the area of the two valves may be but an inch or two. The boiler should still be fitted with a common safety-valve, the duplex valve being loaded to a little more than the proper working pressure, so that it would only act in cases of emergency. It should be kept out of the way of the stoker, as, when it does act, it will not close until the steam pressure is reduced low enough to enable the superior weight on the larger valve to bring it down. In this way, whenever the valve is opened, it at once suspends the action of the boiler, and leads to an inquiry into the cause of the irregularity. Valves of this class may be made as double-ball valves, so as to require no weight to balance the pressure, the difference in area causing a corresponding difference in weight in the two valves. Such an arrangement reduces this class of valve to the simplest possible form, and removes one great evil which is too often a source of incalculable mischief—complexity.

JOHN BRAIDWOOD.

Paisley, August, 1851.

[Our correspondent has laid before us sketches of the modifications of his proposed valve, but we have not thought it necessary to engrave them, as his description is perfectly clear without their assistance. We may remind him that his plan is nothing more than the equilibrium, or balanced safety-valve, under a new form. The use of this valve, as a safety-valve, is of considerable antiquity; but it has been before remarked, that a valve requiring little power to elevate it, requires also little to make it stick in its seat. We have some papers relating to this subject in course of preparation, and it is probable that our October part will bear consultation upon it.—ED. P. M. J.]

REVIEWS OF NEW BOOKS.

Railway Machinery: a Treatise on the Mechanical Engineering of Railways; embracing the Principles and Construction of Rolling and Fixed Plant in all Departments. By Daniel Kinnear Clark, Engineer. Imp. 4to. Parts; Plates and Woodcuts. Glasgow: Blackie & Son, 1851.

We have here a new claimant for public support in the field of mechanical literature, and one which promises to contribute some acceptable additions to the library of the practical engineer. So far we have only two parts on which to frame our judgment of its quality. The author reduces his task to two grand divisions—wheeled or rolling plant, and fixed or stationary plant. The first embraces locomotives and tenders, carriages, vans, and waggons, whilst the second includes apparatus for turning wheeled plant, watering and coking apparatus, signals, and weighing tables. The first part is illustrated by well-executed plates of Fairbairn's locomotive "Vulcan," an example of the Great Western Railway carriages, and a set of diagrams of slide valves; and the second has a similar series of supplementary plates of the same subjects, both being pretty closely sprinkled with woodcuts. The first two chapters are devoted to a "general history of the locomotive," and the third and fourth open upon the subject of valve mechanism, filling up the 24 pages of letterpress of which the two parts are made up.

Mr. Clark's scheme extends to 24 parts—to be issued monthly, we presume, but as no dates are affixed, we are left in doubt as to this point—at 2s. 6d. each. When we have a few more parts before us, we may venture upon an outline of the author's treatment of the extensive subject which he has chosen. The few pages already in existence, however, show us that his descriptions are lucid, and his language concise.

The Principles of Colour applied to Decorative Art. By G. B. Moore. Pp. 74. London: Taylor & Walton, 1851.

This little work, by the teacher of drawing in the University College, London, sprung from a wish on the part of the author that the introduction of coloured decorations in this country should be successful, and that the system of painting our public buildings in uniform dull monotonous flat-tints might have an end. We think it is calculated to further the cause the author has at heart. He does not confine the application of decorative colouring to arabesques, foliage, and ornaments of that description, but would extend it to the proper use and distribution of every colour and material used in the embellishment of buildings, the hue of the materials for constructive purposes not being neglected. Nor does he confine his remarks on this mode of decoration to public buildings. The embellishment of private residences is also considered.

His leading principle, which we think is the true one, is, that the primary (yellow, red, and blue) and secondary positive colours (orange, violet, and green) should not be employed in large quantities; but that the tertiary hues, formed by a mixture of three primary colours, with one predominating, or the quartiary hues, formed of the three primaries, with two or a secondary colour predominating, should form the principal masses, reserving the primary and secondary positive colours to heighten the effect, or attract attention to the points of interest. It was by this principle, he says, that the decorators of the best ancient interiors in France, Belgium, and Italy were guided, as well as the great painters of the Venetian and Flemish schools, in their charming productions.

Tables for the Use of Architects, Engineers, Surveyors, Builders, Mahogany, Deal, and Timber Merchants, and others concerned in Valuations. By James Wale. Pp. 55. Derby: Horsley, 1851.

Assuming the figures in these tables to be correctly given, we have no doubt that they will be acceptable to persons whose business it is to price deals, battens, timber, mahogany, and other logs. The prices being affixed in pence and decimal parts of a penny, the real value is more nearly shown than on the old system, in which considerable looseness appears to exist. The author states that his tables were originally drawn up for his own use, without any design of publication, but he has been induced to place them before the world at the request of many intelligent practical persons.

Account of the Holophotal System of Illuminating Lighthouses, being a description of the light of maximum intensity. By Thomas Stevenson, C.E. Pp. 36. Edinburgh: Neill, 1851.

This pamphlet is a republication of a paper originally printed amongst the Transactions of the Royal Scottish Society of Arts, with the addition of an appendix. The original paper obtained the Keith gold medal in November, 1850. It sets out by reminding its readers that by no arrangement of instruments, however ingenious, can more light be thrown off than what proceeds from the flame. All that can be done is, as far as possible, to prevent loss by absorption, or irregular scattering of the rays given off by the luminous body, so that a light of maximum intensity (*holophotal*) may be transmitted in the required direction. The great loss of light by the apparatus usually employed in lighthouses, induced Mr. Stevenson to inquire into the possibility of increasing the intensity of illumination by changes in the optical arrangements. As to the success which has attended Mr. Stevenson's investigations and experiments, it will be sufficient to refer to the report of the committee appointed by the Royal Scottish Society of Arts to examine his system. That committee consisted of three able mathematicians, namely, Professor Kelland, and Messrs. A. Bryson and W. Swan of Edinburgh. It reported that the improvements are of the greatest value, and it recommended the society to testify its approbation of them in the strongest form. For a description of what these improvements are, we must refer to the pamphlet itself, where will be found several engravings illustrating the new arrangements, and a paper drawn up by Mr. Swan, embodying the mathematical formulæ for constructing the particular mirror required therein.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

TWENTY-FIRST MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

At a meeting of the general committee, Belfast was chosen as the place of meeting in 1852, and Colonel Sabine was elected president. The following grants were made:—

£300 for the maintenance of the observatory at Kew.
£50 as a renewal of the former grant to Prof. J. D. Forbes, for experiments on the radiation of heat.
£20 to Mr. Robert Hunt, Dr. G. Wilson, and Dr. Gladstone, to continue their investigation on the influence of the solar radiation on chemical combinations, electric phenomena, and the vital powers of plants growing under different atmospheres.
£15 to Prof. Ramsay, to prepare a large geological map of Great Britain and Ireland, to accompany the Section and Association.
£10 to Prof. E. Forbes and Prof. T. Hall, to assist Dr. Williams to draw up his report on British annelida.
£6 to Hugh E. Strickland, Esq., Dr. Daubeny, Dr. Lindley, and Prof. Henslow, to continue their report on the vitality of seeds.
£20 to Lord Monteagle, Sir J. Boileau, Mr. G. R. Porter, Mr. Fletcher, Dr. Stark, and Prof. Hancock, to prepare a report on the census of the United Kingdom.
£20 to Mr. A. W. Fairbairn, to make a series of experiments on the tensile power of wrought-iron boiler plates at various temperatures.

Professor Phillips announced that 711 persons had taken part in the proceedings of the Association during the week—of whom 87 were foreign gentlemen of distinguished eminence. The money received was £620.

Friday, July 4.

G. B. Airey, President, in the Chair.

Section A.—Mathematical and Physical Science.

Prof. Powell's report "On Luminous Meteors," continued from the report of 1850, was the first communication.

"Remarks on Lord Brougham's Experiments on Light, &c., in the Phil. Trans. 1850, Part I.," by the Rev. Prof. Powell.—The experiments of Lord Brougham on the properties of light are regarded by their author as offering new facts at variance with the principle of interference, hitherto so successfully applied to all phenomena of this class. They seem, therefore, to call for some remarks as to their actual bearing on the question. The experiments all refer to the well-known phenomena of diffraction fringes formed by the edge of an opaque screen, which the author views in connexion with a peculiar theory of inflecting and deflecting forces; the nature of the effect being chiefly investigated by placing a second edge at some distance from the first along the ray, and occasionally a third, which produces changes in the breadth and position of the fringes. In the author's attack on the interference theory (especially in Prop. xi.), a considerable misconception of that theory appears to be involved. Though the undulatory theory has been successfully applied to the general subject of these fringes, yet it is well known that the application of the formulæ to any but the simplest cases of edges and apertures is defective, owing to the great complexity of the resulting expressions, and the impossibility of interpreting them except under very restricted conditions. Thus, the integration has not been extended to the case of a square aperture (considered in one of these experiments), nor again to the action of a second or third edge at different distances,—this last case being obviously the same as that of an aperture or screen whose plane is inclined to the path of the rays. Fresnel, in his justly celebrated memoir ("Sur la Diffraction de la Lumière," *Mém. de l'Institut.* tom. v. for 1821, published in 1826, note, p. 452), considers briefly this very case. He points out the conditions necessary for determining the position of a given fringe, and shows generally that the fringes will not be symmetrical, having a greater extension towards one side; but he does not give any analytical investigation, which would manifestly be one of considerable complexity. I some time since requested a friend eminently versed in the mathematical part of the subject, to deduce these expressions at length, and ascertain what results would probably be attainable. That request

has been so far complied with that I am able to state that the integrals are extremely complicated, though it seems difficult to say whether they may not yield to proper treatment: the main question is, whether the expenditure of time and trouble would not be greater than any results likely to be obtained would repay?

Sir D. Brewster remarked, that the principal fact which Lord Brougham considered of great importance seemed to have been overlooked by Prof. Powell—that after a beam of light had suffered one diffraction, by being made to pass one diffracting edge, a second edge placed on the same side of the beam seemed to have no further power of either increasing or modifying the diffraction; but a diffracting edge placed on the opposite side of the beam, seemed to produce its full defractive effect, just as if no diffraction had already taken place. This the noble author of the experiments considered to be evidence that the beam which had already suffered diffraction had acquired a species of polarity, or diversity of polarity, on its opposite sides. Lord Brougham did not wish to establish or overthrow any particular hypothesis by these experiments; and he (Sir D. Brewster) agreed with Prof. Powell, that they did not affect the undulatory theory.—Prof. Stokes, Prof. Steveley, and Mr. Rankine, pointed out reasons why the second diffracting edge placed on the same side of the beam should not produce any further diffraction, but should produce that effect on the opposite side, where it would stop the course of the other portion of the diverging beam.

"On M. Guyot's Experiment," by Prof. Powell.—The recent experiment of M. Foucault, giving direct proof of the earth's rotation, having excited so much attention, it seems remarkable that an equally striking one, devised and tried by M. J. Guyot, in 1836, should have been passed over or forgotten. That gentleman observed, that as a falling body deviates to the east, a long plumb-line ought to do the same. This experiment he performed in the dome of the Pantheon, at Paris, with a plumb-line about 172 feet long, and determined the deviation to be $4\frac{1}{2}$ millim. in 57 mèters. His mode of experimenting was by small balls, one at the point of suspension, the other at the weight, whose images, strongly illuminated and reflected in a basin of mercury placed below, were viewed from above, and found to coincide when the eye was laterally distant $4\frac{1}{2}$ millim. from the upper ball. The experiment might probably be simplified without the trouble of illumination, by making the suspension from a line passed across a small circular aperture in a flat roof, the light coming through which would probably give a sufficiently light image in the mercury below. The effect is also stated to be sufficiently perceptible with much less length than that above stated. The author was merely desirous of calling attention to this experiment, in the hope that it will be repeated with due care in this country.

Papers were then read "On the Zodiacal Light," "On some unusual Atmospheric Phenomena," and "On the Establishment of a Midland Observatory," by Mr. E. J. Lowe.

Mr. F. C. Bakewell read a paper "On the Copying Electric Telegraph," and illustrated its action by experiments with the instruments.—In the method adopted for transmitting copies of writing, the letters to be transmitted are written on tinfoil with varnish, so as to present a conducting and a non-conducting surface. The foil is placed on the cylinder of the transmitting instrument, and a metal style in connection with a voltaic battery presses on the surface of the cylinder as it revolves. By this means the electric current is continually broken when the style is resting on the varnish, and as the style is made to traverse by an endless screw from one end of the cylinder to another, it passes necessarily over all the lines of the writing, and about eight times over each line. The receiving instrument is similar to the transmitting one, and on the cylinder of that instrument, paper, moistened with a solution of prussiate of potash in diluted muriatic acid, is placed; the metal style on that instrument being a piece of steel wire. When the electric current from the positive pole of the voltaic battery passes through the steel point to the paper, a blue mark is made by the production of Prussian blue, and when the cylinder is in motion, the effect is to draw a series of spiral lines on the paper; but as the lines are broken whenever the varnish writing on the transmitting cylinder interposes, the forms of the letters are transferred from one instrument to the other—the writing appearing of a pale colour on a ground of blue lines drawn closely together. To produce this effect, it is requisite that both instruments should rotate exactly together, and this synchronous movement is attained by means of an electro-magnet, one instrument being made to regulate the other by retarding its motion at regular intervals. The regulation of the instrument is also facilitated by a guide-line, consisting of a strip of paper placed at right angles to the writing, by which means the person in charge of the receiving instrument can ascertain exactly how much the speeds of the two instruments differ, and by the addition or abstraction of weight can bring the gaps formed by the strip of paper to fall exactly under each other—which indicates that the two cylinders are revolving at the same rate. It was stated, in answer to questions by members present, that two hundred letters per minute might be copied by the instruments exhibited, and that five hundred in a minute are attainable. To illustrate the facility which this means of telegraphic communication affords for transmitting secret messages, an apparently blank piece of paper was produced, on which a message had been impressed invisibly before the meeting of the Section, and by brushing it over with a solution of prussiate of potash the writing became instantly legible.

"On a new Elliptic Analyser," by Professor G. G. Stokes.

"On Diamagnetism and Magne-Crystallic Action," by Dr. J. Tyndall.—One of the most important inquiries which at the present day occupy the attention of the student of physical science, is the relation which subsists between magnetism and diamagnetism. Are the laws which govern both forces identical? Will the mathematical expression of the attraction in the one case be converted into that of the repulsion in the other case, by a change of sign from positive to negative? To this question Plücker replies, "No." His experiments have led him to the conclusion, that when the power of a magnet which operates upon a body composed of magnetic and diamagnetic constituents is increased, the diamagnetism of the compound mass increases in a much quicker ratio than the magnetism; that, in consequence of this, an indifferent body is a physical impossibility; for a body in which the respective forces might be exactly equal and apposite when excited by a magnet of a certain strength, would, upon lowering the power of the magnet below this standard, be attracted; and by increasing the power of the magnet beyond this standard, be repelled. During a previous investigation, the author of the present memoir had repeated opportunities of observing phenomena exactly similar to some of those which form the premises of Plücker's conclusion; and a close study of the subject convinced him that to account for these phenomena, the hypothesis of two conflicting forces in the same compound mass—the one or the other of which predominates according as the power of the magnet is increased or diminished—was by no means necessary. To fit himself for the investigation of this question, he commenced an inquiry last November into electro-magnetic attractions; one of the results of this inquiry was, that a sphere of soft iron, separated from the end of a straight electro-magnet by a small fixed distance, was attracted by the latter with a force exactly proportional to the square of the exciting current. Now, this attraction is, in each case, the product of two factors, one of which expresses the magnetism of the magnet, and the other the magnetism of the ball; and it is easy to see, that while the attraction increases as the square of the current, the magnetism of the ball increases in the simple ratio of the current itself. Our way to a comparison of magnetic attraction and diamagnetic repulsion is now clear. We know the law according to which the magnetism of the iron ball increases, and we have only to inquire whether the diamagnetism of the bismuth ball follows the same law. The apparatus used in the former case proved, however, to be totally unfit for the measurement of diamagnetic force—the feebleness of the latter rendering a much more delicate mode of measurement necessary. The torsion balance was the instrument finally resorted to by the author. A loop of paper was attached to one end of a fine silver wire, and in the loop rested a little beam of light wood. At the ends of the beam, which was six inches long, two spoon-shaped hollows were worked out, in each of which a ball of the substance to be experimented with might be placed. Two cones of soft iron, surrounded by helices of copper wire, were placed at right angles to the beam when horizontally suspended, the one cone facing the ball at one end, and the other cone facing the ball at the other end. The silver wire was carried upward through a tube three feet in length, and was connected at the top with a torsion head. When the cones were excited, by sending an electric current through the surrounding helices, the balls were repelled. The index of the torsion head was then gently turned against the repulsion, until the balls were brought within $\frac{1}{10}$th of an inch of the ends of the respective cones. The torsion necessary to effect this is evidently the expression of the repulsive force exerted at this particular distance. The strength of the exciting current was measured by a galvanometer of tangents, and it was regulated by means of a rheostat. The cones were excited by currents which varied from 10° to 57°, and the corresponding repulsions were determined. Spheres of the following diamagnetic substances were used:—1. Bismuth of commerce; 2. Chemically pure bismuth, obtained by dissolving the material of commerce in nitric acid, precipitating it with distilled water, washing the precipitate for six days successively, and reducing it by means of black flux; 3. Sulphur of commerce; 4. Spheres from a crystal of native sulphur obtained in Sicily; 5. Calcareous spar from Clitheroe; 6. Calcareous spar from Andreasberg, in the Hartz mountains, Germany. In all these cases the diamagnetism of the spheres followed precisely the same law as the magnetism of the sphere of soft iron—it was exactly proportional to the exciting current. These results cannot be reconciled with the statement that diamagnetism increases with the increasing power of the magnet in a much quicker ratio than magnetism. The experiments of Plücker might be accounted for in many ways, but such explanations, being necessarily conjectural, may be omitted here. It is known that crystalline bodies suspended between the poles of a magnet exhibit phenomena which are absent in the case of amorphous bodies. A certain line through the crystal will take up a certain determinate position; and if this line be forcibly moved away from this position, when the force is removed it will return to it. Thus, a crystal of pure carbonate of lime suspended by a silk fibre between the poles, with its optic axis horizontal, will always turn until the optic axis is perpendicular to the line joining the poles, in which position it will come to rest. This fact was discovered by Plücker, who referred it to the operation of a new force which was entirely independent of the magnetism or diamagnetism of the mass of the crystal. In an investigation conducted by the author in companionship with Professor Knoblench of Marburg, this hypothesis of a new force is rejected; and it is there shown that the position of the optic axis, so far from being independent of the magnetism and diamagnetism of the mass, is entirely changed, if a magnetic constituent be substituted for a diamagnetic. Thus, for instance, carbonate of iron differs from carbonate of lime only in the fact, that in the former case an atom of iron is substituted for an atom of calcium. The crystalline form in both cases is identical, the optic axis of carbonate of iron sets nevertheless from pole to pole with an energy far surpassing that with which the optic axis of carbonate of lime sets perpendicular to the line joining the poles. But why is it that one direction in the crystal takes up a particular position? The torsion balance gives a prompt answer to this question. A sphere of calcareous spar was placed upon each of the spoon-shaped hollows of the beam, the direction of the optic axis through each sphere being carefully marked. The spheres were first placed so that the optic axes were parallel to the axes of the soft iron cones—and secondly, perpendicular to the same. The repulsion in the former case was to the repulsion in the latter in the ratio of 53 to 48. If a bismuth crystal be suspended between two poles, the plane of most eminent cleavage will always set perpendicular to the line joining the poles, that is, equitorial. A cube formed from this crystal was placed on each end of the little beam; *first*, so that the planes of principal cleavage were parallel to the axes of the cones; and,

secondly, perpendicular to them. The repulsion in the former case was to the repulsion in the latter in the ratio of 53 to 38. The diamagnetic mass in both these cases is repelled with a greater force in one direction than in any other direction. When the crystal is suspended between two poles, the line which marks the direction of maximum repulsion recedes as far as possible from the poles, and hence sets equatorial. A result, the exact antithesis of the above, was observed with magnetic crystals. A cube of sulphate of iron was attracted in one direction by a force of 43, and in another direction by a force of 36·3. A sphere of carbonate of iron was attracted in the direction of the optic axis by a force of 43, and in a direction perpendicular thereto by a force of 30·5. When these crystals are suspended between two poles, these lines of chief attraction approach the poles, and finally set axial. Thus we see that the peculiar phenomena exhibited by crystals in the magnetic field are to be referred to a modification of magnetism or diamagnetism, brought about by the peculiar structure of the crystal. Let us endeavour to penetrate this mystery of structure. Our next inquiry is, What direction is that which is chosen by the respective forces for the manifestation of their greatest energy? To this question the author imagines that a full and intelligible reply is returned by experiment. If the arrangement of the component particles of any body be such as to present different degrees of proximity in different directions, then the line of closest proximity (other circumstances being equal) will be that of strongest attraction in magnetic bodies, and of strongest repulsion in diamagnetic bodies. The torsion balance furnishes us with the means of submitting this conclusion to a direct test. A quantity of bismuth was ground to dust in an agate mortar, gum-water was added, and the mass was kneaded into a stiff paste. This was placed between two glasses and pressed together. From the mass, when dried, two cubes were taken, the line of compression being perpendicular to two of the faces of each cube, and parallel to the other four. Suspended by a silk fibre in the magnetic field, upon closing the circuit, the line of compression turned strongly into the equatorial position, exactly as the plane of most eminent cleavage in the case of the crystal. The cubes were placed one upon each end of the torsion balance, first with the line of compression parallel to the axis of the cones, and secondly, perpendicular thereto; the repulsion in the former case was to the repulsion in the latter in the ratio of 53 : 30. A greater differential action was thus exhibited in the case of the model than in the case of the crystal. A pair of cubes constructed in the same manner from powdered carbonate of iron, exhibited an analogous predominance of attraction in the line of compression. Against this mode of experiment, an objection was urged during the meeting of the British Association at Edinburgh last year, by Professor William Thomson of Glasgow. "You have," he said, "reduced the mass to powder, but you have not thereby destroyed the crystalline form; your powder is a collection of smaller crystals, and the pressing of the mass together gives rise to a predominance of axes in a certain direction, so that the repulsion and attraction of the line of compression which you refer to closeness of aggregation is after all a product of crystalline action. Besides, we know that compressed isinglass exhibits the same optical phenomena as crystals, and you are unable to prove that the action is not due to a *quasi* crystalline structure induced in the gum by compression." The following experiment will set this point at rest. It will not only show the influence of compression apart from the mere arrangement of the axes, or from the influence of the gum, for none will be used; but it will also demonstrate the total nullity of this presumed axial force where opposed to the influence of compression. To this experiment I was conducted by the following accident. The investigation was conducted in Berlin, and the great electro-magnet of the University was beside me at the time. Some notion of the power of this magnet may be gathered from the fact, that the copper helices alone which surrounded the iron pillars which composed the magnet weighed 243 pounds. On the top of the pillars two moveable masses of soft iron were placed, each weighing about 25 pounds, and between these the substance to be examined was suspended. Before I had thoroughly made the acquaintance of the instrument, I hung a fine cube of bismuth crystal between these moveable poles; on closing the circuit, the planes of most eminent cleavage receded to the equator. Scarcely, however, was this attained when I observed the poles moving towards each other, and before I could break the circuit, they had rushed together and clenched their iron jaws upon the crystal. The latter was reduced by the pressure to about three-fourths of its primitive thickness, and it immediately occurred to me, that if the theory of proximity were true, it ought to tell here. The pressure brought the particles of the crystal in the line of compression more closely together, and hence a modification, if not an entire reversion, of the former action might be anticipated. Having liberated the crystal, I boiled it in hydrochloric acid, so as to remove any impurity it might have contracted by contact with the iron. It was again suspended between the poles, and completely verified the foregoing anticipation. The line of compression—that is, the magnecrystallic axis of the crystal, which formerly set from pole to pole, set now equatorial. The experiment was then repeated with a common vice; various pieces of bismuth protected by plates of copper were placed within its jaws, and there pressed to the thickness of a shilling. The plates thus obtained, when suspended from their edges in the magnetic field, exhibited one unvarying result; the line of compression stood always equatorial, and it was a matter of perfect indifference whether this line was the magnecrystallic axis or not. In these cases no gum was used, and not only was a predominance of axes present, but they all worked together; they were further assisted by the great mechanical advantage offered by such plates to diamagnetic repulsion; the line of compression nevertheless triumphed over all, and determined the position of the crystal. The author concludes his paper as follows:—"Whoever denies the influence of proximity will have to answer the following questions—How is it possible that a greater differential action can be exhibited by a cube of bismuth dough than by the crystal itself? What is it which causes the magnecrystallic axis to forsake its usual position, and to set equatorial when the crystal is compressed in the direction of that axis? He must further assume a crystalline structure on the part of wax, flour, shale, and the pith of fresh rolls; for, in all these substances, the line of compression determines the position of the mass in the magnetic field."

At the conclusion of the paper, Professor Faraday rose, and spoke at some length on the valuable contribution to science which had been brought before them by Dr. Tyndall. It afforded him great gratification that there was one at least among us who had followed up this important subject so perseveringly. The beautiful laws established by Dr. Tyndall proved the identity of magnetism and diamagnetism in one important particular—a result which he always anticipated; and if the crystalline action could be explained by what might be called the gross mechanical experiments brought before them, the discovery was one of the utmost consequence. It gave him pleasure to be able to propose a question to one who had worked so long at the foundations of this matter. Many philosophers had affirmed that it was possible to convert attraction into repulsion, and *vice versa*, by merely varying the magnetic power. This was contrary to his own experience, and he wished to ask Dr. Tyndall whether he had ever met a case of the kind.—Dr. Tyndall stated in reply that he had diligently sought for such a case, but had never succeeded in finding it.

Professor Faraday felt prepared to admit that some of Dr. Tyndall's results seemed to promise an explanation of Plücker's perplexing results and conclusions; but, for his own part, he was anxious to keep his mind free from bias, to get well-established facts, and to free them as much as possible from all circumstances which could mark, or disguise, or mislead, in the interpretation of them; and such being his fixed determination and settled habit, he was rather at a loss to remember to what portion of his publications on the subject Dr. Tyndall referred, when he imagined him to have considered the facts now brought forward as improbable.

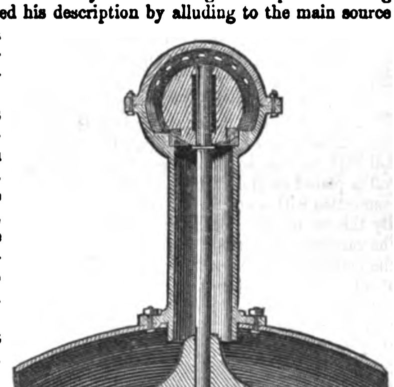
Saturday was devoted to excursions into the neighbourhood of Ipswich.

THURSDAY AND FRIDAY.

SECTION G.—MECHANICAL SCIENCE.

"On Railway Chairs and Compressed Wooden Fastenings," by Mr. May.

Mr. J. Nasmyth described his improved safety-valve, which appears to be characterised by remarkable simplicity of construction and efficacy of action, and likely to afford the utmost security which a safety-valve can against explosion arising from undue pressure. He prefaced his description by alluding to the main source of derangement and uncertainty in the action of safety-valves as hitherto constructed, namely, the employment of a conical-bearing surface in the valve and its seat, which renders the use of a spindle and guide-socket requisite, so as to constrain the valve to rise from its seat in a direction absolutely vertical to the seat or bearing. This guide-spindle, to be of any service, has to fit the socket in which it works with considerable precision, in consequence of which any mud or incrustation which may chance to get upon the spindle of the valve tends to prevent its rise, and so far arrest its action. In order to remove this serious defect, a spherical bearing has been employed, which, as permitting the valve to fit its seat in any position, dispenses with the necessity of any guide or spindle. The grand feature in Mr. Nasmyth's improvement, however, consists in the peculiar mode by which a constant slight movement is given to the valve in its seat by employing the motion of the water, during ebullition, to so act upon the valve as to furnish the means of preventing it ever becoming set fast in its seat. This important object is attained in the most simple manner, by attaching to the bottom of the weight which hangs down inside the boiler



(and which weight is attached to the valve by an inflexible rod), a sheet-iron appendage, which, dipping a few inches into the water, transfers the constant swaying motion of the water to the valve in its seat, and so keeps it constantly free and ready to rise whenever the pressure attains the required force. Mr. Nasmyth exhibited several diagrams, drawn by the valve itself, which gave the most clear evidence of the existence and nature of the motion which the valve derives from the action of the water on the sheet-iron appendage before named. These diagrams were obtained by attaching a pencil to the top of the valve, and permitting it to draw upon a card such figures as resulted from the incessant slight motion of the valve. These interesting proofs of the success of the action of the valve attracted much attention.

"On the Progress of the Wave System of Naval Construction," by Mr. J. Scott Russell.

"On an Improved Direct-action Steam-Fan for the more perfect Ventilation of Coal Mines," by Mr. Nasmyth.

"On the Application of Chilled Cast-Iron to the Pivots of Astronomical Instruments," by Mr. May.

"On the Duplex Rudder and Screw Propeller," by Captain Carpenter.—To construct a vessel on this plan, the deadwood, sternpost, and rudder are removed from their former position, and the midship keel, which before was placed in a straight and horizontal line from stem to stern, is now made to rise up on a graduated scale from the midship section to the water line of the midship part of the stern, where it terminates. The additional keels lie in a parallel line with the midship keel, but placed at a distance of two or more feet, according to the size of the vessel, on either side of it, terminating near to the midship section in the fore part, and in a line with the former sternpost in the after part. A sternpost is placed at the end of the additional keels, and upon each of them hangs a rudder. Framework is carried down to these keels in proper architectural lines for speed, at the same time connecting the frame together, so that the strength of the vessel is increased in the after section, where it is most required in a screw-steamer Between this framework a channel is formed for the water to pass away freely in a direct line with the midship keel. A screw propeller works in an orifice in each framework on the common arrangement. One of the propellers is a little more aft than the other to allow full play to both, and yet economise space in the mid-channel. The propellers turn each of them towards the centre line of the vessel for propelling, and the reverse way for backing. A steering-wheel is placed on the deck in the usual way, and connected with the tillers, which move the rudders together in parallel planes, or separately, as may be required. The propellers can be lifted out of the water, for sailing, by means of a simple apparatus, which is placed on the deck for that purpose, or they may be feathered if preferred. This arrangement is found, by experiments, to have the best effect for steering and propelling, although this new form of vessel admits of many variations of adapting the ordinary propeller or other propellers to it; for example, the common paddle-wheel may be placed on the sides of the vessel in the usual way, or the common screw-propeller may be placed between the framework, or sailing vessels may be constructed on this principle. The advantages of the duplex-rudder and screw-propeller may be considered under three heads—*first*, as regards the two rudders; *second*, the two propellers; and, *third*, the construction of the vessel. To explain the advantages fully of having two rudders to a vessel instead of one, it will be necessary to refer to what has actually taken place practically on this model, as I have not been able to make any experiments on a larger scale up to this time. The duplex-rudder has the power of turning the vessel about in the extremely short space of less than once and a half of her own length, with the helm put hard over on starting, and going full speed all the time till the circle has been completed. A single rudder of the same size, placed in a line with the midship keel on the same model, and propelled in the usual way with a screw-propeller in the deadwood, will not turn a vessel about in less than four and a half times her own length under similar circumstances. This fact shows the infinitely superior power and command there is over a vessel at all times with the duplex-rudder in comparison with that in general use, and consequently, that accidents by collision would be, in a great measure, prevented, and the general safety of steam-vessels better secured by its adoption. Moreover, as either of the rudders, on the duplex principle, can be used to steer with singly, it is evident that, in the event of damaging either one or the other, the vessel would be still under command, and therefore safe from immediate danger—when a vessel fitted with a single rudder would be in a perilous position.

Professor Piazzi Smyth read a description of an ingenuous and simple method of applying the power of wind to a pump, for the purposes of irrigation—as put into practice at the Cape of Good Hope.

MONDAY.

"On the Proposed Railway Communication between the Atlantic and Pacific Oceans, through the British Territories of North America," by Mr. Doull.—I will advert to Mr. Asa Whitney's project for the construction of a railway from Lake Michigan to the Pacific, through the territory of the United States, which has deservedly attracted considerable attention in England. It is quite clear, that in the paper read before the Royal Geographical Society, on the 9th of June, 1851, Mr. Whitney has injured his cause in the estimation of the British public, by taking too wide a range, by claiming for his proposed line the whole of the traffic between Europe and China, and the islands of the North and South Pacific Oceans, discarding alike the existing routes by the Isthmus of Suez, the Cape of Good Hope, and Cape Horn, and by asserting that, should the Isthmus of Panama be swept from its position, and a complete union of the two seas be effected, the commerce between Europe and the rest of the world would not flow to any appreciable extent through that channel, but would be attracted to his proposed line of railway communication. Had Mr. Whitney based his project upon its own intrinsic and legitimate merits and resources, characterized it as a mere local line, or, at most, a United States line, and not designated it as the highway and the only highway of nations, it would have assumed more of a *bona fide* and practical character; and it is quite clear that Mr. Whitney could afford thus to narrow the operations of his project, as it is evident that, if a belt of land thirty miles on each side of a line of railway is colonised, and brought into profitable cultivation (which supposition is the basis upon which the success of this project rests), abundant traffic would be created to work the line, keep it in repair, and to furnish a sinking fund for renewal. The project, when divested of all extraneous and adventitious circumstances, appears to be nothing more than this: there has existed for a considerable time, and there still exists, a continuous tide of emigration setting to the west, but with its frontage extending from the boundary of the British provinces on the north to the Gulf of Mexico on the south. Mr. Whitney, conceiving it desirable to reach the Pacific as soon as possible, proposes to converge the present extended frontage of location to a belt of land sixty miles in extent, and thus to accelerate the westward tendency in proportion to the frontage thus narrowed. In order to change this direction by drawing a sufficient number of settlers into this proposed sixty-mile belt, he must hold out advantages superior to those which can be obtained elsewhere. The project, so far as it has been developed, appears to be totally destitute of any systematic arrangement for the location of settlers, or for their government, civil or municipal. Nor has anything been said about the mode in which the numerous and hostile tribes of Indians are to be disposed of. Mr. Whitney, not being an engineer, does not appear to apprehend much difficulty in running his railway across the Rocky Mountains; which he admits to be about seven thousand feet high, and so flat on the top as to preclude the possibility of a tunnel of any reasonable length. To rise 7,000 feet by a gradient of 1 in 100, would require tailing out for a distance of 132 miles, or with a gradient of 1 in 50, equal to a distance of 66. But suppose that the base of the Rocky Mountains is placed upon an elevation of 1,000 feet above the level of the sea, leaving 6,000 feet to be overcome by an ascending gradient, which would require, at 1 in 100, a distance of 113 miles, and 1 in 50, 56½ miles. It is scarcely possible, however, to suppose that gradients of the above character could be obtained in passing this somewhat formidable mountain range, and it is highly probable that the ascent is much more abrupt than to admit of even the steepest of the above gradients to be constructed. It is unnecessary to do more than advert to the more prominent features of Mr. Whitney's plan; and that simply in order to show that there are much greater facilities for the construction of a line of railway in the territories of British North America, and to prevent the public mind of England from being led to suppose that the route through the United States is the only practicable one. The superiority of the British line, not only with respect to facilities of construction, but with reference to the greater variety and the more extensive fields of productive labour which will be opened out in the various rich mineral districts passed through, is so palpable to all who have turned their attention to this important subject, as to force itself upon the attention of the American press. The *New York Tribune* of March 27, 1851, after adverting to Mr. Whitney's project, and expressing fears that it would fail of meeting that support from the Congress of the United States which its importance deserved, proceeds to state that "the route through British America is in some respects even preferable to that through our own territory. By the former, the distance from Europe to Asia is some thousand miles shorter than by the latter. Passing close to the northern shore of Lake Superior, traversing the water-shed which divides the streams flowing towards the Arctic Sea from those which have their exit southward, and crossing the Rocky Mountains at an elevation some 3,000 feet less than at the south pass, the road could here be constructed with comparative cheapness, and would open up a region abounding in valuable timber and other natural products, and admirably suited to the growth of grain and to grazing. Having its Atlantic seaport at Halifax, and its Pacific depot near Vancouver's Island, it would inevitably draw to it the commerce of Europe, Asia, and the United States. Thus, British America, from a mere colonial dependency, would assume a controlling rank in the world. To her other nations would be tributary, and in vain would the United States attempt to be her rival, for we could never dispute with her the possession of the Asiatic commerce, or the power which that confers." The advantages of a communication from the Atlantic to the Pacific in a northern latitude, to connect the great commercial nations of the world, which are principally situated on the northern hemisphere, was early felt by several nations, and great, though unavailing, efforts have been made to discover a north-west passage through the Arctic Regions. Halifax, in Nova Scotia, will possess considerable advantages over New York, in the United States, as the Atlantic terminus of a railway communication across the continent of America, inasmuch as a line drawn from Cape Clear, in Ireland, to New York would pass very close to Halifax, and thus the whole of the coasting distance of the sea-passage from Halifax to New York would be saved. The support of the Government to the Halifax and Quebec Railway was not rendered with that promptitude which was anticipated, considering the favourable report of its own officers, consequently the operations of the association have been delayed. But the Imperial Government has now come forward with the offer of every necessary assistance for the construction of a railway from Halifax to Quebec or Montreal, and which the colonies will be happy to accept. So far, therefore, as the present paper is concerned, the construction of this initial portion—about seven hundred miles—of the great Atlantic and Pacific Railway may be considered as amply provided for. The passage of the Rocky Mountains is doubtless a point of considerable importance, and one upon which it must be admitted there is no data for the formation of any definite plan. All authorities, however, concur in viewing this barrier as much less formidable on the British than on the United States territory. Having crossed the Rocky Mountains, either by ascending to the summit upon lateral spurs, or passing through by a tunnel, as circumstances might determine, the line would take the direction of Fraser's River, to the Pacific Ocean. The numerous and spacious harbours, with secure anchorage, and a rare combination of maritime advantages, in the vicinity of Vancouver's Island, with an abundant supply of coal, point to this locality as the site of the future capital of the West.

Mr. Asa Whitney explained at great length the steps already taken by him for inducing the States to support his plans for forming his line on the United States territory, from New York to Columbier River, and showed that, to a certain extent, he accorded with the views of Mr. Doull; as, in case of his own plan not being adopted by Congress, he was prepared to make a similar proposition for running his

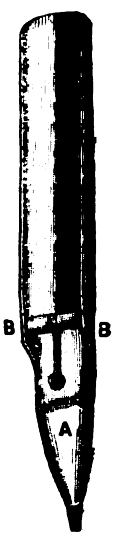
line on the British territory.—Captain FitzRoy, R.N., ably supported Mr. Whitney's views, demonstrating that there was not any serious engineering difficulties to be overcome—that the reason why the plan had not been taken up warmly by the States, was entirely political, and that the slavery question materially interfered with it.—Mr. Bayley raised the question of the impediments arising from snow and frost on any line of railway during the winter.—Mr. Whitney's line passed from 42° to 46° of latitude, whereas the Canadian line would pass nearly at 50°. The further the line proceeded north the less obstruction there would be from snow. If there was little moisture there must be little snow, and that very light—there was more snow in a southern latitude. Single line, with 64lb. rail, 15,000 dollars per mile.—Mr. Doull, in reply, remarked that emigrants going to Canada could find nothing to do, and some left for the States, where they found employment, and were soon independent. The principal intention of the paper is to draw attention to this very anomalous state of things, and to open out public works for the encouragement of emigrants from Great Britain to settle in the British territories instead of the United States.

"On an Improved Condenser for Marine Engines," by Mr. J. S. Price.

TUESDAY.

"On an Improved Mode of Casting the Specula of Telescopes," by Mr. Nasmyth.

"On an Improved Modification of the Reservoir for Gold Pens," by Mr. J. Thomson.—A slightly-worn quill pen is generally esteemed the best instrument for affording quickness and ease in writing. The leading objection to steel pens is, that they scratch the paper, if not when new, certainly after they have been exposed for a short time to the corrosive action of the ink. In gold pens the points may be made of any form, but if they be made as blunt as would be desirable for imitating the slightly-worn quill pen, it is found that the ink is discharged in much too great quantity on the paper, and that thus the writing is blotted, and inconveniently frequent dipping of the pen is required. The reason why the capillary attraction has so much less power to hold up the ink in the gold pen than in the quill one, is to be found in the difference of form of the two pens. In the gold pen, the part to which the ink adheres requires to be tapered very much, so as to produce the requisite flexibility in so rigid a material. In the quill pen, on the contrary, the semi-cylindrical part extends very nearly to the point, and contains the upper part of the drop of ink. The hollow form thus given to the drop of ink in the quill pen has, according to the laws of capillary attraction, a powerful tendency to sustain the ink; while the convex form of the drop in the gold pen tends to force the ink down on the paper. The objections thus arising to the gold pens are more than remedied by the application of the reservoir which forms the subject of the present paper.



The reservoir is composed by adding to an ordinary gold pen a small plate, or tongue, of gold, represented at A, in the annexed figure. It is in the space between this tongue and the pen that the ink is held, and the capillary attraction is so powerful as to allow the ink to flow from the pen on the paper only in a moderately thin film. The tongue is attached to the pen by a hinge, B B, which admits of its being opened widely out from the pen for cleaning, and also of its being turned completely back, so that the pen can be used without the reservoir. This is sometimes desirable; as, for instance, if a few words only are to be written, and there should happen to be no convenient way to dispose of a reservoir full of ink when the writing is done. By friction at the hinge, B B, the tongue is made to remain in any position in which it may be placed. This friction is produced by means of a slit (shown in the figure) proceeding through the tongue from the middle of the hinge, and permitting the barrel of the hinge, originally made a little longer than the space in which it works, to be compressed longitudinally when put into that space by the maker, so that it always tends to expand, and thus presses outwards against the pen. Friction between the barrel of the hinge and the pin which passes through it, would be, for various reasons, objectionable.

The reservoir pen just described must be considered only as an improved modification of Riddle's patent one, which has been for some time manufactured by Mr. Mordan. The new modification has met with the full approval of the proprietors and manufacturer of the old one, and they have come to the determination of adopting it in place of that with which they have hitherto supplied the public.

[More than a year ago we had a gold pen sent to us by Mr. Josiah Jackson of Birmingham, the inventor, with a modification on a principle somewhat similar to that of Mr. Thomson. A small flap was cut out of the barrel portion, and bent down to form a capillary reservoir. It answers its end in retaining a good supply of ink, and, when fitted into a quill barrel, forms a very useful and convenient pen.]—Ed. *P. M. Journal.*

"On the Construction of Iron Vessels exposed to Severe Strain," by Mr. W. Fairbairn.—In the construction of vessels, such as boilers, pipes, &c., exposed to severe internal pressure, it is desirable to obtain some knowledge of the strength and condition of the material used, and some fixed rules calculated to enable us to judge with accuracy as to the disposition of the parts, in order to apply the greatest strength in the direction of the greatest strain,—and, in fact, so to dispose of the material, that every part of the vessel shall balance itself in its powers of resistance when subjected to uniform pressure. To attain these objects, the author gave the results of his experiments on the resistance of malleable iron plates, first announced to the British Association, and subsequently published in the Transactions of the Royal Society. These experiments were originally undertaken to determine the strength of metal plates, beams, and angle iron, as applied to ship-building; and they have since been continued, from time to time, for the equally important purpose of improving the construction of malleable iron bridges, boilers, and other vessels, such as caissons and sheet-iron pipes, which are now coming into more general use for pump-trees and other articles connected with mining. In order to acquire satisfactory data on the strength of the material employed, a variety of plates from Low Moor, Staffordshire, and other parts, were submitted to direct experiment; first, by tearing them asunder in the direction of the fibre, and secondly, across it. The tensile strength per square inch was ascertained to be as follows:—

	In the direction of the fibre. Tons.	Across the fibre. Tons.
Yorkshire plates	24·26	26·93
Derbyshire plates	21·68	18·65
Shropshire plates	22·82	22·00
Staffordshire plates	19·56	21·01
Mean in tons	22·16	22·29

From this it will be observed, that there is no difference in the strength of iron plates whether torn in the direction of the fibre or against it, and this uniformity of strength probably arises from the superior manner in which that article is now manufactured. The experiments would, however, be imperfect as regards construction, if they had not been extended to the process of riveting; and on this point our information has been of the most meagre description. Until of late years, many of our numerous constructions have been conducted under the impression, that the riveted point was not only strong, but absolutely stronger than the plate itself; whereas, more than one-third of the strength is lost by that process. To prove the fallacy of these views, it was ascertained by experiment that the strength of iron plates, as compared with their riveted joints, was not only weakened to the extent of the quantity of metal punched out to receive the rivets, but that in the following ratios, viz., as 1000 to 700 in the double-riveted joint, and 100 to 560 in the single-riveted joint. From the above facts, practical formulæ have been deduced to show that the maximum resistance of single-riveted plates does not exceed 27,000 lb. to the square inch; and taking into account the crossing of the joints, and other circumstances peculiar to sound construction, 34,000 lb., or 15 tons per square inch, has been found to be the maximum strength of riveted plates such as those used for boilers and similar constructions. In conclusion, attention was directed to several important improvements in connection with the construction of steam boilers, by the introduction of gussets to strengthen the flat ends and retain them in shape. After noticing that all boilers should be of the cylindrical form, Mr. Fairbairn observed that where flat ends are used, they should be composed of plates one-half thicker than those which form the circumference. The flues, if two in number, to be of the same thickness as the exterior shell, and the flat ends to be carefully stayed with gussets, of triangular plates and angle iron, connecting them with the circumference and the ends. The use of gussets is earnestly recommended as being infinitely superior to, and more certain in their action than stay rods. They should be placed in lines diverging from the centre of the boiler, and made as long as the position of the flues and other circumstances in the construction will admit. They are of great value in retaining the ends in shape, and may safely be relied on as imparting an equality of strength to every part of the structure.

MONTHLY NOTES.

Award of the Northumberland Life-Boat Prize.—The prize so liberally offered by the Duke of Northumberland for the best life-boat, has been awarded, on the report of the committee of examination, to James Beeching of Great Yarmouth. The relative values of the plans and models entered for the contest were expressed by numbers, 100 being supposed to represent a complete and perfect life-boat:—James Beeching's number was 84; Henry Hinks, Appledore, Devon, 78; J. and E. Pellew, Plenty, Newbury, 77; William Teasdel, Great Yarmouth, 75; Harvey and Son, Halifax, Ipswich, 74; George Farrow, South Shields, 72; Semmens and Thomas, Penzance, 72; George Palmer, Nazing Park, Essex, 70; William Van Houten, Rotterdam, 70; Alexander Robinson, Hartlepool, 70; J. and J. Harding, Whitby, 70; Forest and Laurie,* Commercial Road, 70; Thomas Gaze, Mundesley, 70; William Greener, Aston, Birmingham, 70; George Lee, Tweedmouth, Berwick, 68; R. Littlejohn and Son, Spittal, Berwick, 67; John Edmund, Scarborough, 67; William Falkingbridge, Whitby, 66; Thomas Costain, Liverpool, 65; William Cambridge, Filey, Yorkshire, 65; Joseph Hodgson, Blyth, 65; R. Taylor, Newcastle, 65; W. Goodridge, Swansea, 65; Johnston and Haines, Brighton, 65; John Cockey, Portsmouth, 64; Thomas Wake and Sons, Sunderland, 63; Benjamin Birch, South Shields, 63; John Thompson, Rotherhithe, 63; J. Bertram, East Street, Manchester Square, 63; R. Tredwen, Padstow, 63; Robert Blair, South Shields, 63; C. F. Gower, Ipswich, 63; T. and

* Out of the mass of entries, a number of the most meritorious were selected for actual trial in practice. Amongst these was that of Mr. R. W. Laurie of Glasgow, who, it will be seen, holds the respectable position of 70 in the list; the name of Mr. Forest, of Commercial Road, being associated with Mr. Laurie's as the builder. A description, with illustrative engravings, of Mr. Laurie's ingenious plan, will be found at page 285, vol. ii., of this *Journal.*

J. White, Cowes, 62; John Arrowsmith, Gosport, 62; Charles Gurr, Portsea, 62; John Lister, Sunderland, 62; Josiah Jones, Liverpool, 61. Besides the persons named in the above list, there were 285 competitors of various degrees of merit.

ROLLING PLANT OF THE MIDLAND RAILWAY.—The return of working stock of this line shows that it consists of 287 engines and tenders; 125 first class, 62 composite, 175 second class, and 295 third class carriages; 14 post-offices and tenders; 110 horse-boxes; 100 carriage-trucks; 143 break and parcel-vans; 7,047 waggons, and 87 break-vans. The increase in the stock, during the half year, consisted of 8 engines and tenders, 2 first class, 5 composite, 4 second class, and 97 third class carriages, and 147 waggons. There are about 3,000 waggons, the property of other parties, employed for the mineral traffic. The cost of the working stock to the 30th of June amounted to £1,753,184, including £48,577 for additional stock during the past year. The number of miles of railway on which the traffic is worked is 521, and the average cost of working stock per mile is £3,365.

IRISH PEAT.—Sir Robert Kane's report to the Lord-Lieutenant, with reference to Mr. Reece's patent, and the establishment of the Irish Peat Company, contains the following comparison of the chemical products obtained by analysis in the Museum of Irish Industry (of which Sir Robert is director), with the products set forth in Mr. Reece's prospectus:—

From 100 parts of peat.	Reece.	Average results of Museum trials.
Sulphate of ammonia,....................	1·000	1·110
Acetate of lime,....................	·700	·305
Wood naphtha,....................	·185	·140
Paraffine,....................	·104	·125
Fixed oils,....................	·714 }	1·059
Volatile oils,....................	·357 }	

With regard to this comparison, Sir Robert Kane remarks:—"It is evident that the quantity of ammonia obtained is rather greater than that expected by Mr. Reece; secondly, that the quantity of oils and paraffine may be considered the same; thirdly, that the quantity of wood naphtha expected by Mr. Reece is more than we obtained in average, but not more than was obtained in some Museum trials. That the quantity of acetate of lime expected by Mr. Reece is more than double that which was in average obtained in the Museum, unless the commercial acetate of lime, calculated for by Mr. Reece, shall contain such excess of lime, &c., as shall render its weight double that which the pure article, calculated in the result of the Museum trials, should have. This latter circumstance may possibly explain the difference. It may, therefore, be admitted that the statements made as to the quantities of those bodies obtainable from peat have not been exaggerated, and, indeed, are such as should immediately be inferred to be obtainable from a body of its constitution, compared with coal and wood" As to the cost of production, Sir Robert regards the problem as so difficult that he refrains from pronouncing a positive opinion. But seeing that the manufacture is of a novel character, with numerous complex collateral operations, and that it is to be established in localities where the people are not accustomed to manufacturing industry, heavy expenses must be looked for. The report concludes with these words:—"Although the excessive returns stated by the proposers of the manufacture may not be obtained, it is yet probable that, conducted with economy, and the attention of individual interests, the difficulty connected with so great complexity of operations would be overcome, and the manufacture be found in practice profitable; and certainly it must be regarded as of very great interest and public utility, that a branch of scientific manufacture should be established specially applicable to promote the industrial progress of Ireland, by conferring a commercial value on a material which has hitherto been principally a reproach, and by affording employment of a remunerative and instructive character to our labouring population."

THE JUSTICE OF PATENT RIGHTS.—When it is said that a privilege of this nature is unjust, we suppose that what is meant to be asserted is, that the community generally is injured thereby; that invention is by this means retarded, in place of being promoted; that, in short, an inventor would be more likely to undertake the labour of discovery, if he knew that he must rely wholly upon his own ingenuity for the protection of his secret, than if he was aware that the law would endeavour to aid him in the maintenance of his peculiar privilege. If this be so, we admit at once that the opponents of a patent law are in the right. But what reason have we to believe in the truth of this assertion? What circumstances in support of it are adduced by those who make it? We are not speaking of those persons—rare indeed, in every sense of the term—who seek for no other reward than the pleasure of discovery, and the contemplation of the benefit it will confer on their fellows. The law is not made for such men, neither does its existence interfere with them, or their mode of proceeding. They give their inventions to the world, and have their reward in the admiration and gratitude of mankind. The law, however, regards those who wish to derive a pecuniary benefit from the result of their labour, inquiry, and ingenuity; and we ask what such men would do, supposing no law existed by which they could secure a property in that which they had discovered? The answer is obvious; they would endeavour to keep their process a secret, and in those cases in which secrecy is impossible, they would have no motive to go through the trouble and expense of discovery. Where secrecy might be possible, we should find the new process fenced round by every mystery and mystification which the ingenuity of the discoverer could devise. Secrecy would be enforced on workmen, as far as possible, by keeping them in ignorance; and when this became no longer feasible, the sanction of oaths would be employed to that end. A state of most painful suspicion and restraint would be the condition of every one who was in possession of an invention, and of all whom he employed. A more mischievous, as well as a more disagreeable condition, can hardly be conceived. The necessary uncertainty of success, after every precaution taken, the suffering and expense attendant upon all such endeavours, would prove a heavy counterpoise to all expected benefit from the invention. Thus, under this system of no privilege, a large class of discoveries would be wholly without protection, and the remainder would be most imperfectly, and with great labour and expense, guarded against unfair appropriation. On the other hand, putting aside for the moment any consideration of the difficulty attending the means of attaining such an end, let us ask what would be the effect of a promise made by society to every *bona fide* inventor, that he should enjoy an exclusive property in his discovery for a limited period? If such exclusive property could be insured, if the right itself could be accurately defined and easily acquired, society would, in so far as depended upon the law, have done its utmost to foster a spirit of discovery, because thereby it would render certain such reward as the invention itself really deserved; and to itself society would not by this means do injury, for although there would be some delay in the full and universal enjoyment of the benefit, whatever it might be, resulting from the invention, yet, upon the whole, ultimately there would be a greater harvest of discovery than would accrue from a system by which no reward was provided for him from whom the benefit came. With common men the common motives to exertion must be relied on, and society, by thus judiciously protecting private interests, would promote the general welfare.—*Times.*

MR. CLEGG'S SCHOOL OF CONSTRUCTION.—We have much pleasure in directing the attention of our younger readers to the contemplated establishment of a School of Construction in London, under the superintendence of Mr. Samuel Clegg, Jun., M. Inst. C.E., F.G.S. Mr. Clegg states, that his school "is intended to prepare gentlemen, about to enter the profession of civil engineers or architects, for the duties of the office, and for field-work; to give them a knowledge of the principles of construction, and the methods of drawing structures for the use of artificers, and thus to render them useful when articled; to prepare them to understand the reasons for the various dimensions and dispositions of material, which they will find in works intrusted to their partial charge, and so to learn practically what they have been previously taught theoretically." He divides his code into two parts—the first being intended for those possessing no previous acquaintance with the subjects; and the second or senior division, for students who have gone through courses of instruction in the applied sciences. The programme which Mr. Clegg has laid before us exhibits considerable tact and care in its compilation. The name of Mr. Clegg, associated with that of his father, must be well known to the generality of our readers in connection with various scientific pursuits. He at present holds the important appointment of Lecturer on Civil Engineering at the Royal Engineer Establishment at Chatham, and Professor of Civil Engineering and Architecture at Putney College.

REMARKS ON THE GREAT EXHIBITION.—To pursue the difficult question of the tendency of mechanical production, and the influence of increased facilities upon the condition of the workman, would involve us in a greater length than we propose in this present article. Unquestionably, the immediate results are often suffering and hardship to individual workmen, and often to a whole trade. But we cannot quite address ourselves to the logic of arguments, that improved modes of production, which confessedly place the article within the reach of a greater number, are to be retarded in order to benefit a minority; that the course of science is to be checked; that knowledge is baneful; and that either particular modes of production, or particular habits and manners in men, are to be kept up solely for the existence of particular trades and particular classes of artisans. Moreover, those who enter into these arguments are prepared to show, that the social machine rights itself in a much shorter time than might have been anticipated. We well recollect the fearful prognostications at the commencement of the railway system. Caricatures of distracted innkeepers and delighted horses were to be seen; and what was shown in caricature was true, at least for the time, as to the innkeepers. The coaching glories of Lichfield, Northampton, and St. Alban's, passed to places which had been too small to dread railways; new towns rose with wonderful rapidity, and the old became melancholy and deserted. We need not tell what every one knows; though let the artisan class bear in mind, that from the development of the railway system a great amount of new employment has been gained, and families once struggling against reverse of fortune are now contented and happy. And if we say that the very innkeepers and horses had soon more to do than ever before, and that towns which had rejected railways got looped in, bitterly lamenting, then we shall have simply told the story of the last sixteen years. But the moral we cannot omit. It is, that the antidote to these temporary hardships must be supplied by education, by the development of *mind* in the workman; and for this antidote the means exist in this Exhibition. By debasing the workman to a mere machine, it has followed necessarily that the human machine was superseded, sooner or later, by the superior mechanism which springs from mind. Immediate advantages of concentration of attention and subdivision of labour were the limitation; and it may not unreasonably be inferred, that the recent prevalence of insanity even has been the result. Improved education, and the development of mental energy, would not only lead to the discovery of new sources of employment, indispensable in a state of progress, but would, at the same time, substitute an honest pride and pleasure in the perfect execution of even mechanical work, the increasing want of which is a main cause of the inferiority of many works of art, and a constant source of annoyance to architects, and loss in buildings, to the public. From the brickwork and joiners' work, or ironmongery in a house, down to a chair or an umbrella, lowness of price, without the asserted durability, is universal; and the ingenuity, and even pleasure, which both dealers and workmen evince in the practice of a deception, is equalled by the readiness of the public to deceive themselves. As we cannot grasp the reasoning of a Chancellor of the Exchequer, that because *chicory* is

sold, *coffee* has been available to a class which had not before used it, so we regret the prevalence of the delusion which exists in buildings as in every other commodity. Many amongst the class of building artisans appear to disregard directions as to work, for the mere pleasure of practising a deceit. For this pleasure, we must substitute the pride of producing good work, and this antidote, we repeat, may be found in this Exhibition. We could have hoped that the influence of the Exhibition would have been exerted in the removal of a delusion before referred to, namely, that expense and elaborate work are *indispensable* to the production of beauty. Beautiful, indeed, and suggestive as are many of the objects of the Exhibition, there appears to be an entire absence of that cheap beauty which would be within the reach of all classes. The attainment of this object would have been the more desirable, since recent attempts to extend the influence of Art, in association with objects of decoration and utility, have fostered rather than discouraged the delusion, and so have not advanced the objects of those who have made them. What has to be done, in fact, is to invest every form of utility with the attributes of ART, and this alike from the most elaborate work of architecture, to the least important article of furniture, or the meanest utensil. Certain principles which have to be kept in view are alike in all these cases. They correspond with those which the most enlightened artists are endeavouring to bring to the regeneration of architecture; they are in many respects distinct from those which determine the forms of painting and sculpture, and, perhaps, have never yet been accurately perceived and exemplified in the architecture of any age. They depend, indeed, upon the constant recognition of the fact, that the reason must be satisfied, as well as the eye delighted; and the want of this recognition is the great fault in the numerous designs for decorative objects, now held up to notice as excellent works of art. We think that the Exhibition may be made the means not only of contributing to the advancement of architecture, but of placing it in a position in which it has never yet stood; but there are particular circumstances in connection with manufactured art which should be guarded against, although not precisely in the manner urged by those who deny the value of multiplication of copies. As for the collection of grates, ironmongery, furniture, and all those objects which afford interest to the architect, they cannot be viewed without advantage,—since the greatest difficulty is often felt in obtaining knowledge of the existence of particular inventions and contrivances. As a complete collection of these things, the Exhibition is, of course, not to be regarded. It is from the uses of the Exhibition, on which we have dwelt above, that its chief value will be felt.—*Architectural Quarterly Review.*

MEMOIR OF JACOB PERKINS.—Jacob Perkins was descended from one of the oldest families of that ancient portion of the state of Massachusetts, the county of Essex—a region of stubborn soil, but rich in its production of *men*. Matthew Perkins, his father, was a native of Ipswich, and his ancestor was one of the first settlers of that town. Matthew Perkins removed to Newburyport early in life, and here Jacob Perkins was born, July 9th, 1766. He received such education as the common schools of that day furnished, and nothing more. What they were in 1770 may be guessed. At the age of twelve he was put apprentice to a goldsmith of Newburyport, of the name of Davis. His master died three years afterwards; and Perkins, at fifteen, was left with the management of the business. This was the age of gold beads, which our grandmothers still hold in fond remembrance—and who wonders? The young goldsmith gained great reputation for the skill and honesty with which he transformed the old Portuguese *joes*, then in circulation, into these showy ornaments for the female bosom. Shoe-buckles were another article in great vogue; and Perkins, whose inventive powers had begun to expand during his apprenticeship, turned his attention to the manufacturing of them. He discovered a new method of plating, by which he could undersell the imported buckles. This was a profitable branch of business, till the revolutions of fashion drove shoe-buckles out of the market. Nothing could be done with strings, and Perkins put his head-work upon other matters. Machinery of all sorts was then in a very rude state, and a clever artisan was scarcely to be found. It was regarded as a great achievement to effect a rude copy of some imported machine. Under the old confederation, the state of Massachusetts established a mint for striking copper coin; but it was not so easy to find a mechanic equal to the task of making a die. Perkins was but twenty-one years of age when he was employed by the Government for this purpose; and the old Massachusetts cents, stamped with the Indian and the Eagle, now to be seen only in collections of curiosities, are the work of his skill. He next displayed his ingenuity in nail machinery, and at the age of twenty-four invented a machine which cut and headed nails at one operation. This was first put in operation at Newburyport, and afterwards at Amesbury, on the Merrimac, where the manufacture of nails has been carried on for more than half a century. Perkins would have realized a great fortune from this invention, had his knowledge of the world and the tricks of trade been in any way equal to his mechanical skill. Others, however, made a great gain from his loss; and he turned his attention to various other branches of the mechanic arts, in several of which he made essential improvements, as fire-engines, hydraulic machines, &c. One of the most important of his inventions was in the engraving of bank bills. Forty years ago, counterfeiting was carried on with an audacity and a success which would seem incredible at the present time. The ease with which the clumsy engravings of the bank bills of the day were imitated, was a temptation to every knave who could scratch copper; and counterfeits flooded the country, to the serious detriment of trade. Perkins invented the stereotype check-plate, which no art of counterfeiting could match; and a security was thus given to bank paper which it had never before known. There was hardly any mechanical science in which Perkins did not exercise his inquiring and inventive spirit. The town of Newburyport enjoyed the benefit of his skill in every way in which he could contribute to the public welfare or amusement. During the war of 1812, his ingenuity was employed in constructing machinery for boring out old honeycombed cannon, and in perfecting the science of gunnery. He was a skilful pyrotechnist, and the Newburyport fireworks of that day were thought to be unrivalled in the United States. The boys, we remember, looked up to him as a second Faust or Cornelius Agrippa; and the writer of this article has not forgotten the delight and amazement with which he learned from Jacob Perkins the mystery of compounding serpents and rockets. About this time a person named Redheffer made pretensions to a discovery of the perpetual motion. He was traversing the United States with a machine exhibiting his discovery. Certain weights moved the wheels, and when they had run down, certain other weights restored the first. The experiment seemed perfect, for the machine continued to move without cessation; and Redheffer was trumpeted to the world as the man who had solved the great problem. Perkins gave the machine an examination, and his knowledge of the powers of mechanism enabled him to perceive at once that the visible appliances were inadequate to the results. He saw that a hidden power existed somewhere, and his skilful calculations detected the corner of the machine from which it proceeded. "Pass a saw through that post," said he, "and your perpetual motion will stop." The impostor refused to put his machine to such a test; and for a sufficient reason. It was afterwards discovered that a cord passed through this post into the cellar, where an individual was stationed to restore the weights at every revolution. The studies, labours, and ingenuity of Perkins were employed on so great a variety of subjects, that the task of specifying and describing them must be left to one fully acquainted with the history of the mechanic arts in the United States. He discovered a method of softening and hardening steel at pleasure, by which the process of engraving on that metal was facilitated in a most essential degree. He instituted a series of experiments, by which he demonstrated the compressibility of water, a problem which for centuries had baffled the ingenuity of natural philosophers. In connexion with this discovery, Perkins also invented the bathometer, an instrument for measuring the depth of the sea by the pressure of the water; and the pleometer, to measure a ship's rate of sailing. Perkins continued to reside in his birth-place till 1816, when he removed from Newburyport to Boston, and subsequently to Philadelphia. His attention was now occupied by steam machinery, which was beginning to acquire importance in the United States. His researches led to the invention of a new method of generating steam, by suddenly letting a small quantity of water into a heated vessel. After a short residence in Philadelphia, he removed to London, where his experiments with high-pressure steam, and other exhibitions which he gave of his inventive powers, at once brought him into general notice. His uncommon mechanical genius was highly appreciated; and his steam gun was for some time the wonder of the British metropolis. This gun he invented in the United States, and took out a patent for it in 1810. It attracted the notice of the British Government in 1823, and Perkins made experiments with it before the Duke of Wellington and a numerous party of officers. At a distance of 35 yards he shattered iron targets to pieces, and sent his balls through eleven planks, one inch thick each, and placed an inch apart from one another. This gun was a very ingenious piece of workmanship, and could discharge about one thousand balls per minute. Perkins continued in London during the remainder of his life. He never became rich. He lacked one quality to secure success in the world—financial thrift. Everybody but himself profited by his inventions. He was, in fact, too much in love with the excitement of the chase to look very strongly at the pecuniary value of the game.

ENGLISH AND FRENCH FILES.—An interesting instance of the superiority of English over foreign files, was recently given at the Cutler's Hall, Sheffield, on the occasion of the entertainment given to the Local Commissioners of the town. The narrator, Mr. Overend, himself a commissioner, stated that there was a French gentleman among the jurors, who very properly showed great zeal in protecting the interests of his countrymen. He had admitted that Sheffield had made the best files, but he maintained that there was a house in France that could make better. He challenged Sheffield to the trial, and he selected the house with which he would make the trial, and it happened to be that of which the mayor (Mr. Turton) is the head. He sent to France to have files made for the purpose. He brought over a French engineer to use them, and he challenged Messrs. Turton and Sons to the contest. Two pieces of steel were selected upon which to try the files, and they were fixed in two vices. Messrs. Turton accepted the challenge, but they did not send to Sheffield to have any files made specially for the occasion. They merely went to a London customer whom they supplied with files, and took files indiscriminately from his stock. They chose a man from among the Sappers and Miners in the Exhibition, to use their file against the French engineer and the French files made for the trial. The two pieces of steel being fixed in the vices, the men began to work upon them simultaneously. The Englishman with Messrs. Turton's file had filed the steel down to the vice, before the French engineer had got one-third through. When the files were examined, Messrs. Turton's file was found to be as good as ever, while the French file was nearly worn out. The French juror then said, no doubt he was beaten in that trial, but Messrs. Turton's file must have been made to cut steel alone, whereas the French file was better adapted for iron. A new trial then took place upon iron, and the result was still more in favour of the English file.

ENGLISH PATENTS.

Sealed from 21st July, to 21st August, 1851.

Arthur Field, Lambeth, gentleman,—"Improvements in the manufacture of candles, night-lights, and mortars."—July 22d.

Samuel Varley, Sheffield, engineer,—"Improvements in retarding and stopping railway carriages, and in making communications between the guards and engine-drivers on railways."—22d.

Thomas, Earl of Dundonald, admiral in Her Majesty's Navy, Chesterfield-street, Middlesex,—"Improvements in the construction and manufacture of sewers, drains, waterways, pipes, reservoirs, and receptacles for liquids or solids, and for the making of columns, pillars, capitals, pedestals, vases, and other useful and ornamental objects, from a substance never heretofore employed for such manufactures."—22d.

James Timmins Chance, Birmingham, gentleman,—"Improvements in the manufacture of glass."—(Being a communication.)—28th.

Richard Lloyd, Paris, France, engineer,—"Improvements in steam-engines and in treating steam."—(Being a communication.)—28th.

Peter Robert Drummond, Perth,—"Improvements in churns."—29th.

John Workman, Stamford-hill, Middlesex, fumist and furnace-builder,—"Improvements in the manufacture of bricks, tiles, and other articles made of like materials."—31st.

Charles Barlow, Chancery-lane, London,—"Improvements in saws."—(Being a communication.)—31st.

Victor Lemoign, Cette, France,—"Certain improvements in rotary and other engines."—31st.

Charles Cowper, Southampton-buildings, Chancery-lane, Middlesex,—"Improvements in locomotive engines, boilers, and carriages, part of which improvements are applicable to other similar purposes."—(Being a communication.)—31st.

James Whitelaw, Johnstone, Renfrew, North Britain, engineer,—"Certain improvements in steam-engines."—31st.

Joseph Mansell, Red Lion-square, Middlesex, manufacturing fancy stationer,—"Improvements in ornamenting paper and other fabrics."—31st.

Charles Perley, New York, United States, machinist,—"Certain new and useful improvements in the construction of capstans for nautical and general purposes."—31st.

Edward de Mornay, Mark-lane, London, gentleman,—"Improvements in machinery for crushing sugar-canes, and in apparatus for evaporating saccharine fluids."—August 5th.

Levi Bissell, New York, U. S., engineer,—"Certain new and useful improvements in the means of sustaining travelling carriages and other vehicles, which improvements are applicable to other like purposes."—5th.

Edwin Deeley and Richard Mountford Deeley, Andman Bank, Stafford, flint and bottle-glass manufacturer,—"Certain improvements in the construction of furnaces for the manufacture of glass."—6th.

Robert Hyde Greg, Manchester, manufacturer and merchant, and David Bowlas, Beddish, Lancaster, manufacturer,—"Certain improvements in machinery or apparatus for manufacturing weavers' healds or harness."—7th.

Lockington St. Lawrence Bunn, Walbrook, London, merchant,—"Improvements in the manufacture of kamptiolicon."—7th.

Alphonse René le Moir de Normandy, Judd-street, Middlesex, gentleman, and Richard Fell, City-road, in the same county, engineer,—"Improved methods of obtaining fresh water from salt water, and of concentrating sulphuric acid."—7th.

Jonathan Grindrod, Birkenhead, Chester, consulting engineer,—"Improvement in the machinery for communicating motion from steam-engines or other motive power, and in the construction of rudders for vessels."—14th.

John Plant, Beswick, Manchester, manufacturer,—"Certain improvements in the manufacture of textile fabrics."—14th.

Thomas Skinner, Sheffield,—"Improvements in producing ornamental surfaces on metal and other materials."—14th.

Stephen Moulton, Bradford, Wilts, India-rubber manufacturer,—"Certain improvements in the preparation of gutta percha and caoutchouc, and in the application thereof."—14th.

Aime Nicolas Derode, Rue-street, Roch, Paris, France, gentleman,—"A certain process for uniting cast-iron to cast-iron and other metals, and for uniting other metals together."—14th.

Joseph Birkbeck, Blundell, New-cross-road, Kent, gentleman,—"Improvements in machinery for sweeping and cleansing roads and ways."—14th.

Henry Glynn, Bruton-street, Berkeley-square, gentleman, and Rudolph Appel, Gerrard-street, Soho, anastatic printer, both in Middlesex,—"Improvements in the manufacture or treatment of paper or fabrics, to prevent copies or impressions being taken of any writing or printing thereon."—14th.

Lot Faulkner, Cheadle, Chester, machinist,—"Certain improvements in the method of obtaining and applying motive power."—21st.

James Robertson, Oxford-street, Manchester, chemist,—"Improved methods of producing or obtaining printing dyes and other substances used in printing; which improvements, in whole or in part, are applicable to other like purposes."—21st.

John Walters, Sheffield, York, manufacturer,—"Certain improvements in knives and forks."—21st.

John Treasahar Jeffree, Blackwall, engineer,—"An improved apparatus for facilitating the more perfect combustion of fuel, whereby funnels in steam-vessels and chimneys, or shafts for factories, may be dispensed with."—21st.

SCOTCH PATENTS.

Sealed from 23d July, to 22d August, 1851.

William Johnson, of the Office for Patents, 47 Lincoln's-inn-fields, Middlesex, 166 Buchanan-street, Glasgow, and 20 St. Andrew-square, Edinburgh, civil engineer,—"Improvements in machinery or apparatus for the manufacture of envelopes."—(Communication.)—July 23d.

Daniel Towers Shears, Bankside, Southwark, copper merchant,—"Certain improvements in the manufacture and refining of sugar."—25th.

Alexander Alliot, Lenton, Nottingham, engineer,—"Improvements in cleaning, dyeing, and drying machines, and in machinery to be used in sugar, soap, metal, and colour manufacturing."—31st.

John Davie Morris Stirling, Black Grange, North Britain, Esq.,—"Improvements in the manufacture of metallic sheets, and in coating metals, and alloys of metals, in metallic compounds, and in welding."—31st.

James Whitelaw, Johnstone, Renfrew, North Britain, engineer,—"Certain improvements in steam-engines."—August 1st.

Charles Cowper, 20 Southampton-buildings, Chancery-lane, Middlesex, patent agent,—"Certain improvements in piling, fagoting, and forging iron and steel for plates, bars, shaft-axles, tyres, cannons, anchors, and other similar purposes."—(Communication.)—6th.

Peter Robert Drummond, Perth,—"Improvements in churns."—6th.

Robert Oxland, and John Oxland, both of Plymouth, chemists,—"Improvements in the manufacture and refining of sugar."—6th.

James Buchanan Mirrlees, Glasgow, engineer,—"Certain improvements in machinery, apparatus, or means for the manufacture or production of sugar."—8th.

Joseph Mansell, Red Lion-square, Middlesex, manufacturing fancy stationer,—"Improvements in ornamenting paper and other fabrics."—August 8th.

William Onions, Southwark, Surrey, engineer,—"Improvements in the manufacture of certain parts of machinery used in spinning."—11th.

Alphonse René le Moir de Normandy, Judd-street, Middlesex, gentleman, and Richard Fell, City-road, in the same county, engineer,—"Improved methods of obtaining fresh water from salt water, and of concentrating sulphuric acid."—13th.

David Farrer Bower, Hunslet, Leeds, manufacturing chemist,—"Certain improvements in preparing rating, otherwise called rotting, and fermenting flax, line, grasses, and other fibrous vegetable substances."—20th.

IRISH PATENTS.

Sealed from 21st July, to 19th August, 1851.

Thomas Allan, Edinburgh, gentleman,—"Improvements in electric telegraphs, and in apparatus connected therewith."—July 23d.

William Beadon, jun.,—"Improvements applicable to the roofing of houses, buildings, and other structures."—August 2d.

David Ferdinand Masnata, Golden-square, Regent-street, Middlesex, gentleman,—"A new mechanical system, with compressed air, adapted to obtain a new moving power."—9th.

Hugh Barclay, 170 Regent-street, Middlesex,—"Improvements in the means of extracting or separating fatty and oily matters, in refining and bleaching fatty matters and oils, animal and vegetable wax, resins, and in the manufacture of candles and soap."—11th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 23d July, to 20th August, 1851.

July 23d,	2891.	Benjamin Nickels, jun., Albany-road, Camberwell,—"Draft or chess board."
26th,	2892.	John Gatliff, King's Arms-yard, Moorgate-street,—"Shawl and other pins."
28th,	2893.	George Holcroft, Manchester,—"Steam generator."
30th,	2894.	John Bellerby, St. George's Saw-mills, York,—"Cart."
July 31st,	2895.	Cox and Wilson, Oldburgh, Oxfordshire,—"Travelling label."
Aug. 1st,	2896.	C. H. Wagnor, Birmingham,—"The Flexibility Regulator" (pen-holder).
—	2897.	W. Steer, St. John's-wood,—"Manifold bladed razor."
—	2898.	J. Griffiths, Liverpool,—"Apparatus for opening, closing, and fastening skylights."
—	2899.	G. Granger, Worcester,—"Steam saucepan."
2d,	2900.	W. Card, Westminster,—"Card's Melodian, or flute tuner."
—	2901.	T. Melling, Ramhill Iron-works, Lancaster,—"Moulding box."
—	2902.	J. Whitworth, Birmingham,—"Button."
5th,	2903.	S. Wilson, Glasgow,—"Life-preserving travelling bag."
—	2904.	D. Adamson and Co., Hyde, Chester,—"Multitubular boiler."
6th,	2905.	Fisher and Bramall, Sheffield,—"Crank-handled screw-tang file."
7th,	2906.	A. Rabett, Newgate-street,—"Military-sleeved shirt front."
8th,	2907.	J. Fuller & Co., Southwark,—"Neoteric ventilating hat."
9th,	2908.	T. Porter, Manchester,—"Hooks and eyes for connecting articles of dress."
11th,	2909.	Myers & Son, Birmingham,—"Peristaltic pen."
13th,	2910.	J. H. Ferguson & Co., Queen-street, Cheapside,—"Railway companion."
18th,	2911.	Thurston & Co., Catherine Street, Strand,—"Pool marking-board."
—	2912.	Joseph Page, Birmingham,—"Universal portable worm cork-screw."
19th,	2913.	J. Whitehouse and Son, Birmingham—"Lock knobs."
—	2914.	R. Brightman and Son, Bristol,—"Sportman's boot."
—	2915.	James Park, Bury, Lancashire,—"Steam boiler or generator."
—	2916.	Jacob Bonallack, Whitechapel and Holloway,—"Staves and stays for van and cart bodies."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 19th July, to 17th August, 1851.

July 19th,	259.	T. W. Stephens, Dublin,—"Wheat cleaning-machine."
—	260.	W. H. Dupré, Jersey,—"Albert roof-light and economical ventilator."
—	261.	R. Anderson, Westor, South Shields,—"Life-boat."
—	262.	R. Powell, Great Pultney-street,—"Military coat or cloak."
22d,	263.	J. Plimsoll, Sheffield,—"Moulding or surface file-holder."
—	264.	J. Plimsoll, Sheffield,—"Moulding or surface file-holder."
23d,	265.	Gregory Kane, Dublin,—"Cabinet to contain portable furniture."
25th,	266.	W. S. Adams, Haymarket,—"Sponging pan or bath."
29th,	267.	W. & J. Harcourt, Birmingham,—"Portable cylindrical writing-case."
30th,	268.	J. Coxon, Paddington,—"Diagonally seated omnibus."
31st,	269.	W. Green, Paddington,—"Safety cash-drawer, or model till."
Aug. 5th,	270.	J. Taylor, Birmingham,—"Dress fastening."
15th,	271.	J. C. Nesbit, Kennington-lane,—"Guanometer, or instrument for testing the purity of guano."
—	272.	James Cook, Knightsbridge,—"Portable mangle."
16th,	273.	Thomas Newcomb, East-lane, Walworth,—"Economic shadowless oil-lamp."
—	274.	Oswald Deitz, Great Pulteney-street,—"Mechanical blood extractor."

TO READERS AND CORRESPONDENTS.

The Patent Laws.—In answer to numerous inquirers, we have to state that the Session of Parliament has concluded without any alteration in the Patent Laws. A short article upon the subject appears at page 133 of our present number. The proceedings in obtaining Letters Patent remain, therefore, as before, full particulars of which are given in "Hints to Inventors," to be obtained at the Offices of this Journal, in London, Glasgow, or Edinburgh, and through the Booksellers.

RECEIVED.—"Improved Application of the Whistle to Locomotive Steam-Engines." By J. A. Tabor.—"On the Amendment of the Law and Practice of Letters Patent for Inventions." By T. Webster.—"Two Lectures on the Construction of Boilers, and on Boiler Explosions." By W. Fairbairn.—"Mechanical Inventions." By L. Gompertz.—"Plain Directions for obtaining Photographic Pictures." By John H. Croucher.—"Improved System of Working Railways." By B. Smith.—"A Treatise on the Screw-Propeller." By J. Bourne.

H. B., Rugley.—His note to us was misdirected, and arrived by a very circuitous route. There is no patent for such apparatus in Mr. Gore's name. We cannot ascertain as to the existence of any registration without a lengthened search. Mr. Gore himself will doubtless afford the information.

W. T., Nottingham.—We have given a brief notice of the machine at page 84 of our *Journal* for July last, but we wished to be put in possession of the mechanical details.

C. R. O., Ramsgate.—As the sketch in our possession conveys no information whatever as to the mechanism, it is of no use to us.

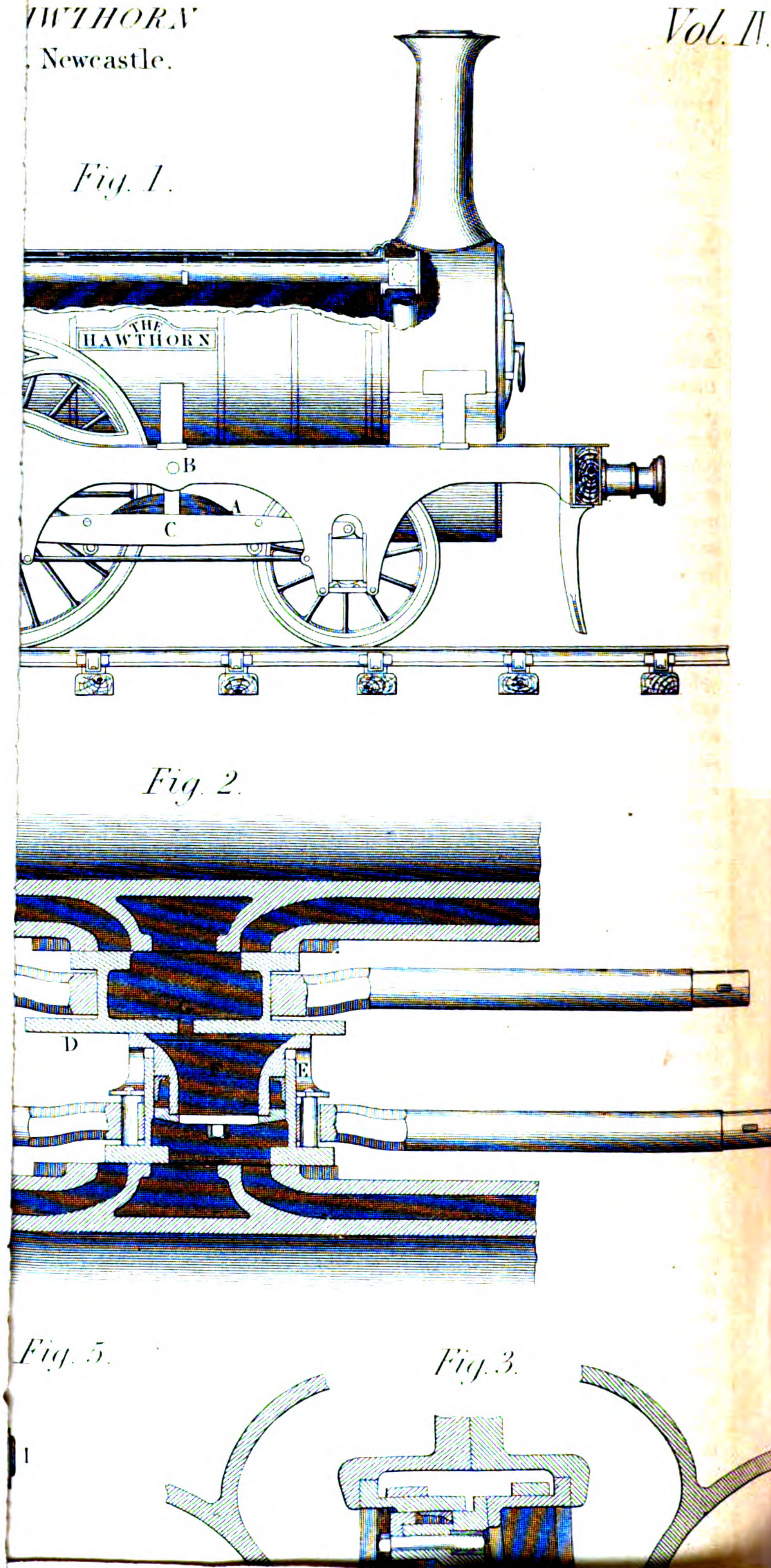
W. M., Manchester.—The sketches are engraved, and will appear in our next part.

ER-ENGINE "HAWTHORN."

IWTHORN

. Newcastle.

Vol. IV.



LOCOMOTIVE MECHANISM IN THE GREAT EXHIBITION.

MESSRS. HAWTHORN'S FIRST-CLASS PASSENGER ENGINE "HAWTHORN"—SHARP'S LOCOMOTIVE SLIDE-VALVE—ADAMS AND RICHARDSON'S "FISHED" RAIL-JOINT.

(Illustrated by Plate 80, and 7 Wood Engravings.)

Side by side with the gigantic champions of the broad and narrow guage locomotives, whose stupendous proportions make us tremble for the unfortunate rails which have to carry them, stands an engine of more modest demeanour—the "Hawthorn," an example of the designing and constructive abilities of Messrs. R. & W. Hawthorn of Forth Banks, Newcastle. This engine, for which the makers claim a capability of safe travelling at eighty miles an hour, with a large express train, is of the six-wheeled inside cylinder class, and embodies four very important points of improvement. These are the *Double Compensating Beams* for distributing the weight more uniformly on the wheels—*Equilibrium Slides—Expansion Link* suspended from the slide-rod—and the *Perforated Steam Pipe* for the conveyance of dry steam to the cylinders. Our engraving, plate 80, exhibits a longitudinal elevation of the engine on a small scale, with five additional detailed figures, delineating the valves and link motion.

Fig. 1 is a longitudinal elevation of the engine on the rails, with a portion of the upper side of the fire-box, cylindrical boiler, and smoke-box broken away, to show the perforated steam-pipe leading to the cylinders. Fig. 2 is a horizontal section of the slide-valve, chest, slides, and steam-ways to each cylinder. Fig. 3 is a corresponding transverse section of the slides, chest, and portions of both cylinders. Fig. 4 is a side elevation of the improved expansion link, showing the two eccentric rod ends, valve spindle, and regulating lever and links. Fig. 5 is a corresponding end or edge view of the link and its appurtenances, a part of the upper end of the link being broken away. Fig. 6 is a plan or horizontal section of the link, showing also one of the eyes of the valve spindle in section.

The cylinders are 16 inches diameter, with a stroke of 22 inches, and the driving wheels are 6 feet 6 inches diameter, with leading and trailing wheels of 3 feet 9 inches. The heating surface of the fire-box above the grate-bars, and exclusive of the spaces taken up by the tube-ends and fire-door, is 98.6 square feet; the total area of the fire-box, including the tube-ends, fire-door, and surface beneath the upper side of the grate-bars, amounting to 110 square feet. This includes a hollow bridge across the centre, forming an additional water space. The tubes, which are of brass, are 158 in number, the external diameter being 2 inches, furnishing a further extent of 865.4 square feet of heating surface.

The leading feature of this engine has reference to the mode in which it is supported on its springs. Instead of fitting a spring to each wheel, two only, A A, are placed on each side of the engine, between the wheels. These springs are inverted, and are sustained by central straps attached at B B to the framing, their ends being connected by short links to the wrought-iron double-compensating beams, C, placed longitudinally on each side of the engine, inside and beneath the framing. The two inner contiguous ends of these beams are linked by a transverse pin to an eye at the bottom of the axle-box of the driving axle, whilst the opposite ends of the beams are respectively linked in a similar manner to eyes on the top of the leading and trailing axle-boxes. The action of these beams is pretty obvious. By them, a direct and simultaneous connection is given to all the axle-bearings, so that a uniform weight is constantly maintained on all the wheels, totally irrespective of any irregularities in the level of the rails on which the engine travels, and an unvarying amount of adhesion is in this way secured. Considerable additional stability and easiness of motion is also found to arise from this system of spring connection—a fact which was fully proved during the run of the "Hawthorn" up to London to the Exhibition.

The slide-valves, figs. 2 and 3, are placed on vertical faces, in a single steam-chest, between the pair of cylinders. One slide has a plate, D, cast or bolted on its back, and planed to correct parallelism with the working face; and the other has an open box, E, cast on its back to receive a piston, F, having an upper or end face, also planed parallel with the valve face. The piston is fitted steam-tight in its cylinder or box, and its planed top bears against the face of the plate, D, in working. By this arrangement the slides are relieved from one-half the steam-pressure; and to assist the free exhaust, a port, G, is formed in the back plate, D, of one of the slides, to allow the escaping steam an additional exit through the piston and exhaust-ports of the opposite valve.

The expansion link, figs. 4, 5, and 6, is placed so as to admit of the very desirable point of lowering the boiler considerably nearer the axle than usual. Instead of connecting the link, H, immoveably to the ends of the eccentric-rods, so as to rise and fall with them in reversing or modifying the expansion, it is here suspended at its centre by an eye, from the end of the slide-valve spindle, I, so that its weight is entirely removed from the reversing gear. The eccentric-rods, J, are jointed to the opposite ends of the link slide-block, which is made of increased length, so as to secure the steadiness and durability of the working parts, whilst the reversing lever, K, has only the weight of the eccentric-rods and slide-block to bear during the reversing movement. The engine-driver has thus a much lighter labour to perform, and a more correct action of the valves arises from the fixed link-centre.

The perforated steam-pipe is an old invention of Messrs. Hawthorn's, but is only now coming into general use. It is fixed into the smoke-box tube plate by a ferule like an ordinary tube, and extends nearly to the full length of the boiler, close to the top, and is perforated with a continuous series of narrow slits, to admit the steam into the pipe directly above its point of generation. By its adoption, dry steam is carried to the cylinders without having recourse to a dome or steam-chest, and the barrel of the boiler, therefore, presents a clear unbroken surface.

Whilst we are on the subject, it may be mentioned that Messrs. Hawthorn were the earliest introducers of the system of four fast eccentrics, this arrangement having been adopted in the "Comet," which was one of the two engines employed in opening the portion of the Newcastle and Carlisle line between Blaydon and Hexham. The other engine associated in the honours of the day was by Messrs. Stephenson, and had two loose eccentrics, with a striking clutch for reversing; but after this time all the makers at once adopted the four eccentrics. The common reversing gearing of the present day, was also introduced by them shortly afterwards in the "Tyne" locomotive, for the same line. The "Hawthorn" has inside and outside framing throughout its entire length, the connection between the two being by double knee-brackets. The cylinders, guide-bars, pumps, and axles, and all the machinery of the engine, are fitted perfectly independent of the boiler, which is not put in its place until all the other details are completely erected.

Mr. W. D. Sharp of Swindon exhibits a "steam-engine, with improved valves and gear," which he has meanwhile secured under the *Provisional Registration Act*. The plan is exemplified in its application both to stationary and locomotive engines, as detailed in the following particulars, with which the inventor has favoured us.

The object and advantages of this improvement on valves will be better understood by referring to the speed and pressure at which steam-engines are now, and have formerly been, worked. The slide-valve now generally used in locomotive and other steam-engines is quite well adapted to the work required of it, when applied to engines working with low-pressure steam, and where the velocity of the piston rarely exceeds 200 feet per minute, which may be taken as the average speed at which engines were worked until the introduction of the locomotive, in which the velocity of the piston is generally not less than 1000 feet per minute when going at the average speed, or say five times the former velocity. The pressure at which steam is now worked is also greatly increased; in locomotives it is seldom less than 100 lbs. per square inch, being about double the pressure in use not more than ten years ago. Now this great increase of speed and pressure has rendered the slide-valve, as at present employed, a very unfit agent for the emission of the steam from the cylinder. It must be understood, that if the speed be five times

greater than formerly, then five times the quantity of steam must pass through the same area of opening in the same time, or the velocity of the steam, in making its exit from the cylinder, will be five times greater than formerly. But this is not all. I have said the steam now worked in locomotives is seldom under 100 lbs. per square inch; now, steam of this pressure, on access being given it to the atmosphere, as by the opening of the valve, will expand to eight times its former volume, and consequently, to get the same free outlet as is obtained in low-pressure engines with the slide, we would require to have $8 \times 5 = 40$ times the area of ports or openings. Those openings have certainly been enlarged in relation to the cylinder, from what they were made some years ago; but to obtain anything like the requisite enlargement with the slide-valve is quite impracticable. The disadvantage resulting from this is shown in the locomotive, where, if the pressure of steam on the acting side of the piston be, say 100 lbs. per inch, a resistant pressure of 40 lbs. or more will be found on the other—thus nearly half the power is expended in expelling the steam from the cylinder. It may, however, be said, that this is in consequence of the blast-pipe—and no doubt, to a certain extent, it is; but then the area of the valve-openings rarely exceeds, and frequently falls under, the area of the blast-pipe—that is, taking the valves when opening the greatest area of ports; but then we must take into account, that with the slide-valve the piston makes one half of the stroke, with a mean area not exceeding one half of the maximum opening. I have no doubt that, with a more free and capacious outlet to the steam from the cylinder, instead of its being throttled in the small and tortuous opening the slide affords it, a considerably larger area of blast-pipe might be used, and with the same beneficial result as regards the draught.

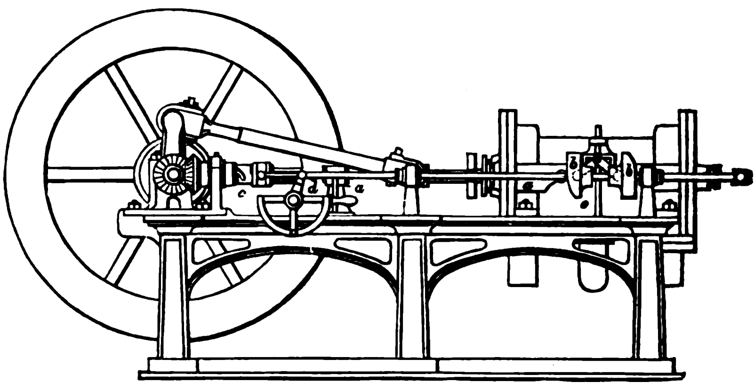
I believe also that much may yet be done in taking advantage of the motion of the locomotive through the atmosphere, which, if done in a judicious manner, would be the means of assisting the blast-pipe in creating the draught, and thus tend still further to its enlargement; but as the valves are at present constructed, little or no advantage can be gained by doing so.

Another great evil attends the slide-valve, viz., the pressure of steam on the back of the slide; and this disadvantage has also been greatly augmented in consequence of the increase of pressure at which engines are now worked. Thus the slide of an 18-inch locomotive cylinder, with the steam at 100 lbs., will have to move under a pressure of 14,000 lbs., which, at a moderate estimate, and the engine going at average speed, will absorb 35 horses' power in working the two slides. But this is not all, nor perhaps the greatest disadvantage attending it, for, from the great force requisite to work the valve, the joints and links connecting it with the eccentric cannot work in the smooth and steady manner so essential; and again, the apparatus is so much more liable to wear, that it is next to impossible to keep up that accuracy of movement in the valve, which is, above all, so desirable.

The object and intention of the valve now to be described, is to remedy those defects that have now been pointed out, and under which the slide-valve labours. Fig. 1 is an elevation of an engine with this valve, and other improvements; and fig. 2 is an enlarged section of the cylinder, showing the valves. The piston is shown at A; B B, are the valve-pistons, which, it will be observed, are placed within the cylinder at each end, the cylinder being made somewhat longer than usual for this purpose. They are each of the same diameter, and furnished with packing-rings similar to the steam-piston. One of them is shown in section, from which it will be observed that the steam exhausts through the centre opening, and that the quantity of steam ineffective in each stroke will be only equal to the depth of the valve-piston and the area of the port or opening made therein. For the purpose of making these valve-pistons as light as possible, I would prefer forming them of thin plate-iron, as there is no other strain on them but that of retaining the packing-rings in their place. The letters, *a a a*, denote the passage for the inlet, and *d d d* for the outlet of the steam, while the arrows indicate the direction of the steam in those passages. These openings extend quite round the circumference of the cylinder, and are connected at suitable points by ribs for the packing-rings to bear against, as shown in the figure.

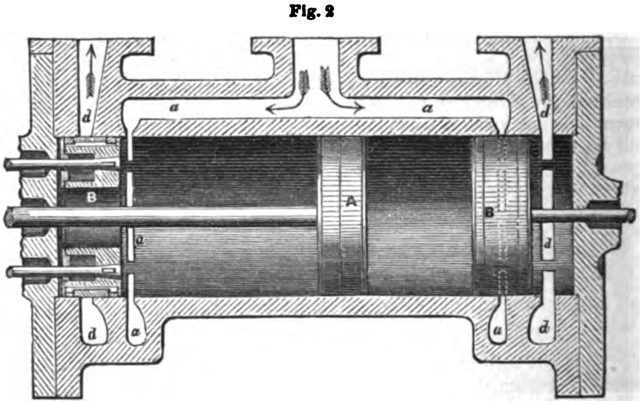
The mode of working these valves which I would prefer, at least for marine and other engines which have not a great velocity, is shown in the elevation, fig. 1. The shaft, *a a*, receives motion from the crank-shaft, by a pair of mitre-wheels, as shown, and has fixed to it two cams, *b b*, which, through coming in contact with anti-friction rollers, attached to the valve side-rods, give motion to the valves. One shaft is sufficient for a pair of engines, care being taken to make the angle between the point of contact of the cams with the valve-rods, the same as that formed by the cranks. The reverse motion is effected by the socket, *c*, which slides on a key fixed to the shaft, and has a spiral slot formed in it, into

Fig. 1.



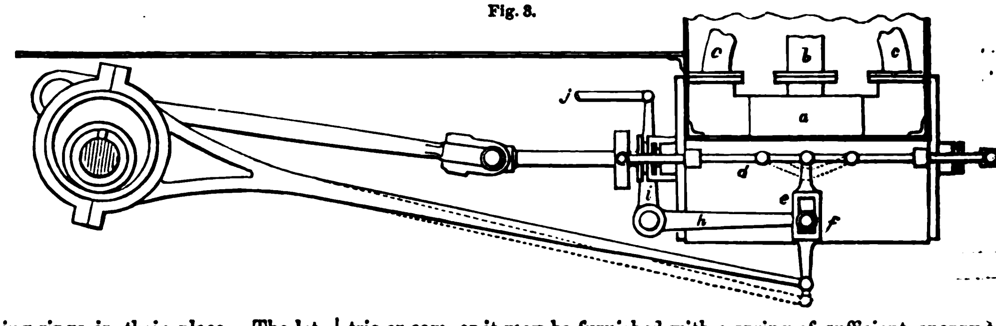
which takes a key, fixed to the mitre-wheel, so that, by moving the socket along the shaft, the position of the cams is changed in relation to the crank, and the motion of the engine thereby reversed; motion is given to the socket, *c*, by the lever, *c d*, as shown. The expansive motion is

Fig. 2



effected by the cross-rod, *e*, and double joint shown, which is attached to the valve side-rods. By raising the rod, the valve-pistons are brought nearer together, and the cut-off of the steam thereby accomplished. This cross-rod may either have a direct motion given it from a variable eccentric or cam, or it may be furnished with a spring of sufficient energy to keep the valve-rod up to the back of the cam, by which a simple, though limited, expansive movement may be given. When the cylinder stands vertically, the valve-pistons will then require to be balanced, in a similar way as the D valve in the same description of engine.

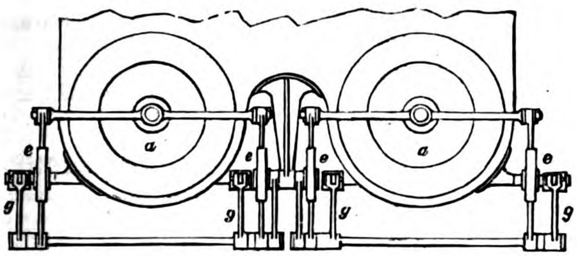
Fig. 3.



The eccentric is quite as applicable to work these valves as it is to

work the ordinary slide-valve. Figs. 3 and 4 show an arrangement adapted to the locomotive with this motion, and having an expansive movement. Fig. 3 is a longitudinal section, taken through the centre of the boiler and smoke-box; and fig. 4 is an end view of the bottom part of the smoke-box, with the cylinders: *a a*, the cylinders; *b*, steam-pipe; and *c c*, exhaust-pipes; *d*, the valve side-rod, jointed, as shown, to the

Fig. 4.



link, *e*, which moves on a fixed centre at *f*. The links, *e e e e*, are attached by the rods, *g g g g*, to the lever, *h*, which, through the lever, *i*, and rod, *j*, is attached to the hand-gear in the usual manner. The sketch is shown as working with full steam; the dotted lines show the position the lever will assume when working expansively. Two sets of eccentrics may be used; in the sketch I have shown only one. The reverse motion to be made in a similar manner to that shown in fig. 1, viz., the eccentrics to be fixed to a socket having a spiral slot formed in it, into which takes a key fixed to the crank-shaft, suitable means being provided for traversing the eccentrics on the shaft. This mode I would prefer, not only because it dispenses with the duplicate eccentrics and rods, but also as it gives the advantage of adapting the *lead* of the valves to suit the various degrees of expansion.

One disadvantage attending the eccentric motion as applied to the slide-valve, will be considerably diminished in its giving motion to this valve. What I allude to is, the slow cut-off of the steam which the eccentric gives through the slide. Now, as the area for the inlet of the steam does not require much enlargement, and as the length of opening will be at least four times that usually given by the slide-valve ports, consequently it will have the same effect in giving a more instantaneous cut-off to the steam, as if the eccentric had at this point been increased to four times its usual velocity.

Messrs. Adams and Richardson exhibit a specimen of their patent "fished" rail-joint, recently successfully applied on the Eastern Counties, and Edinburgh and Glasgow Railways. The term "fish-joint" is a well-known phrase among sailors; and the mechanical arrangement, as applied to the permanent way of railways, is a simple but most effectual mode of securing the rails one to another, with an even continuity of line, uniform elasticity, diminished wear, and security from the often fatal consequences of loose joints. It is to the rocking motion of the locomotive and train that we have to look for the origin of the excessive wear of the permanent way, and this rocking can only be effectually removed by putting an end to the looseness of the rails—an alteration which would have the effect of doing away with the jolting so justly complained of by all railway travellers.

Our engravings, figs. 5, 6, and 7, illustrate the effect of one form of

Fig 5.

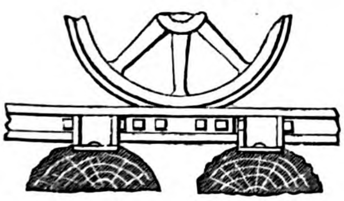
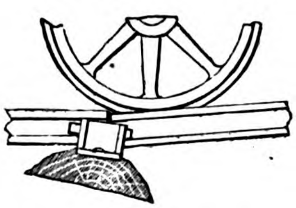
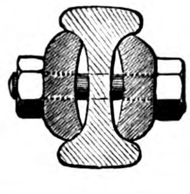


Fig. 6.



fish-joint, which may be taken as a specimen of the system. Fig. 5 is a side view of a joint so fished, showing the powerful support which the arrangement opposes to the wheel; and fig. 6 is a view of the common joint, exhibiting the frequent serious derangement to which it is liable. Fig. 7 is a transverse section of the rail and fishing pieces, on a larger scale.

Fig. 7.



Many attempts have been made to obtain what the fish-joint so effectually accomplishes, by placing the transverse sleepers that uphold the permanent way closer to the rail end than they are in the middle. The consequence of this is, that the permanent way is unequally supported, and being loose at the ends of the rail, when the blow from the engine strikes its middle, it cants the ends up, and the rocking motion and expense of maintenance continues. This canting of the rail, when fish-jointed, cannot take place, although the sleepers may not be at equal distances one from another, for the blow from the engine, as it proceeds, dies away, and the permanent way, for some considerable distance, feels the motion of the coming train. In illustration of this, a smart blow from a hammer was given to one end of about one quarter of a mile of rails, "fish-jointed," and both the sound of the blow, and a slight motion, was perceptible at the other end. It is to be regretted that Messrs. Adams and Richardson's specimen joint, in the Exhibition building, has not been more fortunate in its position, for few engineers or railway directors have seen it.

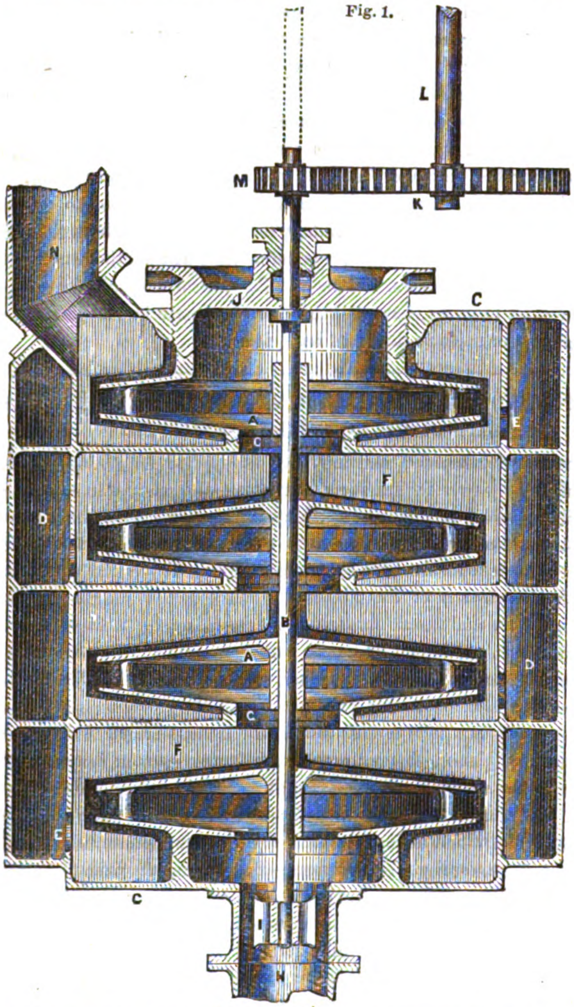
COMPOUND CENTRIFUGAL MINE-PUMP.—CENTRIFUGAL AIR-PUMP FOR STEAM-ENGINES.

Compound or combined blowing-fans, as applied for giving the fan-blast sufficient power for smelting purposes—the invention of which is ordinarily ascribed to Ruthven of Edinburgh—have been long known amongst iron-makers. The plan is to work three distinct fans in connection—the air from the first of the series being blown into the second, which thus receives it at the pressure of the common single fan-blast, and giving it an additional amount of pressure, again delivers it to the third, whence it is expelled at a still higher pressure. The object thus gained, is the securing a powerful blast without driving the fan-shaft at an excessive speed. It is this principle which Mr. Gwynne has successfully employed in a new combination, and in connection with his improved form of piston, to compress air to much greater density, with economy in the actuating power. In all centrifugal machines hitherto applied, the action is much interfered with by resisting currents, involving a loss which is now obviated by the plan before us. He also employs it for a totally new purpose—the raising of water from great depths. Our engraving, fig. 1, represents a vertical section of the compound disc-pump contrived for this purpose. A set of four discs, A, the construction of which we have fully detailed in previous articles on the subject, are keyed on a vertical shaft, B, each disc being contained in its own separate compartment of the fixed external cylindrical case, C. Round this case are cast a set of annular air-chambers, D, communicating with each of the compartments by the opening, E, which are placed alternately on opposite sides of the case. In each division are fixed radial blades, F, cut through, to allow the discs to revolve in pretty close contact with them, their effect being to break the circular current of water after leaving the discs, and cause it to rise freely from one division to the other by the central openings, G. The suction-pipe, H, communicating with the fluid to be raised, has a bearing, I, cast in it to receive and support the lower end of the shaft, B, the upper end of the shaft being secured by the gland and stuffing-box fitted into the balancing-nut, J, at the top of the case.

In the arrangement before us, the pump is actuated by the spur-wheel, K, on the first motion vertical shaft, L, working into the pinion, M, on the end of the pump-shaft to bring up the speed. Or instead of this modification, the pump may be driven direct from the engine by prolonging the main shaft upwards as dotted, or by placing a rotatory or emission steam-engine on the pump-shaft.

The action of this compound pump is best explained by tracing the route of the fluid from the suction-pipe, H, to the discharge passage of the head column, N. If we suppose the lowest division of the case to be filled with water by the revolution of the disc within it, producing the necessary centrifugal force for the upward movement of a current from the pipe, H, then the air contained in the corresponding annular chamber being compressed, acts upon the fluid at a pressure which, for our purpose, may be taken at that of a fluid column 30 feet high. The water is thus urged through the aperture, G, where it enters the second disc, and is here further acted on by a pressure of 60 feet. It next passes, in

Fig. 1.

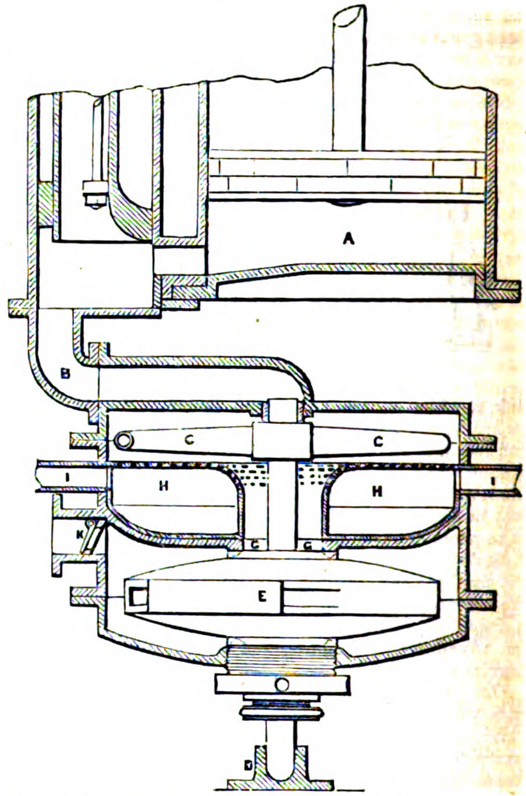


a similar manner, to the third disc, under a pressure of 90 feet, and is finally delivered from the fourth through the pipe, N, at a pressure of 120 feet.

As in the previously cited case of the fan, a great elevating power is secured at a low speed of the pump. If, with a disc of 4 feet diameter, the fluid is raised 30 feet at 200 revolutions, to quadruple the height, or attain 120 feet, we must double the speed of the disc. But with the compound pump of four discs of the same diameter, 200 revolutions will elevate the water to 120 feet, and six discs would accomplish 180 feet. We have illustrated the plan by a set of horizontal discs, but it is evident that, if desirable, they might be worked vertically on a horizontal shaft. In such a case, the air-vessel would necessarily be spherical, and attached to the upper side of the case, instead of being annular, and placed as we have delineated it.

Fig. 2 represents a novel adaptation of the single centrifugal pump, as an air-pump for a condensing engine, the actuating power being derived from a small rotatory emission steam-engine, keyed on the pump-shaft, and driven by the waste steam in its passage to the condenser. The engraving is a vertical section of the lower part of a steam-cylinder, A, with the slide-valve, pump, and condenser beneath. The waste steam passes downwards by the passage, B, from which it enters the open upper tubular end of the shaft, carrying the emission-arms, C. This shaft is supported in a footstep, D, beneath the condenser, through the centre of which it passes upwards, and is supported by a collar-bearing in the top of the steam-case of the emission engine. As the steam issues from the arms, C, it is condensed by cold water admitted through the pipes, I, and drawn through the perforated division over the top of the compartment, H, down through the wide central pipe opening at G, into the central ingress aperture of the pump. The revolution of the pump discharges the water into the lower division of the condenser, whence it flows off by the discharge-valve, K. This arrangement forms a most effective air-pump, as it is very compact, produces a continuous exhausting action, and is economically driven.

Fig. 2.



THE VEGETABLE PRODUCTS OF SCOTLAND.

We have long felt an inclination, amounting to a duty, to notice especially the collection of vegetables contributed by the Messrs. Lawson of Edinburgh to the Great Exhibition. At first glance there would appear little in common between the general objects of our *Journal*, and the particular exposition of a collection of this kind. But when we consider a little, the moral relation will be at once perceived, and the very great importance which ought to be attached by mechanicians of all grades to the labours of those who, greatly through the instrumentality of the improved machines constructed to subserve agricultural purposes, provide the sustenance of man, and are the purveyors, literally, of his daily bread.

Among the many miles of counters and cases in the world's fair, there are few more interesting than that collection which now claims attention. The form as well as the substance of it must be attractive to all who go there with the right kind of eyes, while our friends of the North may with great reason pride themselves upon having sent to the Crystal Palace a contribution which, for excellence, completeness, and elegance, stands second to none. In it we have in reality a *petite* museum, combining every facility to view its objects with ease and profit. Arranged in several extensive cabinets, constructed of mahogany and glass, (in the centre of which is the special superintendent's office,) we can observe at leisure specimens of all the vegetable products of Scotland. There are six divisions:—1. Plants cultivated for their seeds and straw; 2. for herbage and forage; 3. for the roots; 4. for their uses in the arts and manufactures; 5. for medicinal properties; and, 6. those cultivated for their timber. We have drawings of the plants—specimens of them dried—the flowers, the seeds, the various roots, either natural or in wax, and longitudinal and vertical sections of timber and other trees, showing the same section both in the rough and in the polished state, joined in most examples by a hinge, and in some few similar sections of appendant branches. It was a temptation to affix, both to the museum and to the synopsis, the appropriate portion of the first chapter of

Genesis—"God said, Behold, I have given you every herb bearing seed, which is upon the face of all the earth, and every tree, in the which is the fruit of a tree yielding seed;" and this extract from the sacred writings appears in very many languages. We do not envy that individual who can view this collection, and then come suddenly upon this, the appropriate and characteristic motto of it, without some feeling allied very much to a higher one, in which gratitude has taken the place of admiration, and is in its turn supplanted by something beyond.

Not only have Messrs. Lawson been at the expense of fitting up this portion of the Exhibition, but they have been minded and desirous to make it as understandable as possible to all. They are themselves the authors of a Synopsis, which is divided into six divisions as above, each of which forms a distinct quarto volume, or the whole may be had in one. The Synopsis includes a short and interesting history of Scottish agriculture. In it we are occasionally reminded of some curious facts respecting the effects of culture on some plants. For instance, how the poisonous Solanum tuberosum becomes the wholesome potato; the Brassicæ, or cabbage tribe, attains its remarkable changes; how, "from the common or wild cabbage (brassica oleracea), a poor weed-like plant of the sea-coast, it is brought up to be, at will, either the gigantic tree or cow-cabbage, the compact drumhead, the Brussells sprouts, red cabbage, cauliflower, or khol-rabi;" how the poisonous old peach of India becomes the luscious fruit in our gardens; how, "in short, the parts of even ornamental plants extend, those of flowers multiply and reduplicate, and colours change, and vary, and improve under the magic touch of culture." We must finish this very imperfect notice of Messrs. Lawson's collection, with the concluding words in the Introduction to their Synopsis, which we may inform our readers, as characteristic of the general "getting up" of the collection, has been very elegantly printed *at the private press* of the authors.

"We hope that sufficient data have been afforded for appreciating the general scope and bearing of this collection, and leading the spectator to make a more minute and particular investigation for himself. To enter farther into detail here would be unnecessary; nor, indeed, could any satisfactory particulars be embodied in a very popular shape, even though the embodying of these in such a shape were necessary; but it is not necessary. All essential information, however, as to the nature and properties of the vegetable products, that have been collected for the purpose of illustrating the agricultural resources of Scotland, will be found noticed. . . . The desire has been to render clear and accessible to the many thousands who may congregate at this great Industrial Exhibition of all Nations, a knowledge of the leading characters of those plants which are, by art or culture, rendered subservient to the wants of man. In fact, to convey information in so correct and concise a manner as to command the attention of all thinking persons, and to make those who have never opened the book of nature, and to whom the wide world has hitherto seemed a wilderness, to look upon it as at once a garden and a library."

ON THE IMPROVEMENT OF BOILER SAFETY-VALVES.

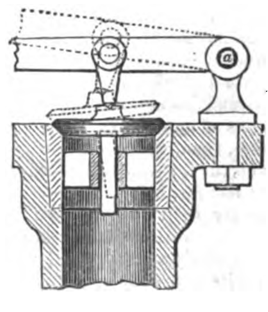
Whatever may be the ultimate causes of explosion in steam-boilers, or to whatever defect of construction, workmanship, or management these disastrous occurrences may be individually traced, it is certain that, in all cases where violent disruption has taken place, the proximate and immediate cause has been pressure, and nothing but pressure. Ingenuity has been taxed, and experimental science has been ransacked, to deduce from ascertained facts in connection with steam, the means of remedying the results of its dangerous properties; whilst, with the same laudable intention, theories without number have been advanced, seeking to throw a light on mysterious agencies other than experiment has confirmed, and to expound hidden properties which never existed. Although, however, comparatively nothing has been effected—although explosions still take place, and in all probability will continue to take place—it is not too much to affirm that the present state of our knowledge on this subject, limited as it may be, is nevertheless amply sufficient to obviate even the chance of danger—that even the simple knowledge of the fact, that pressure alone, from whatever cause evolved, is the immediate forerunner of every explosion, ought to be in itself a sufficient guarantee for its prevention. Precaution, under our existing knowledge, is the only preventative, but it is a safe one—precaution in construction, precaution in workmanship, and precaution in attendance. As, however, this latter is not always to be depended on, and the most careful engineman may sometimes be at fault, it follows that, in the construction of boilers, combined with sound workmanship, too great attention cannot be paid to the means of rendering them so perfect in their self-adjusting action, as to defy the consequences of the most reckless carelessness.

Since, therefore, it is an incontrovertible axiom, that a boiler cannot burst or explode in the ordinary manner without internal pressure, it may be fairly submitted, that if we can devise any precautionary plan whereby it can be relieved from that pressure as fast or faster than it is evolved from any undue cause, the means of perfect security will in all cases be attained, except where some most inordinate and preposterous defect exists.

To effect this desirable purpose, the ordinary safety-valve has been devised; and as it is a plain and simple contrivance, it would appear at first sight to be most effective; but it is not too much to believe, that for the very reason of its being obvious and simple, it has not sufficiently claimed the attention of engineers; and that it may not be so effective as is generally supposed, but is capable of very great improvement, we shall now attempt to show.

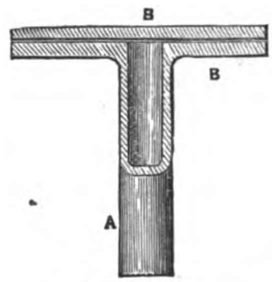
The common safety-valve now in use for boilers working much above atmospheric pressure, is the one shown in fig. 1, being the ordinary weighted lever-valve. In some cases, however, the lever is discarded, and weights are perpendicularly placed over the valve, a preferable mode, in all respects, where compactness and steadiness can be attained.

Fig. 1.



In both cases the valve itself consists of a flat plate, frequently hollowed out on the under side, having a tail or guide spindle, and bearing with its edges on a brass seat, to which it is ground conically. With such a valve, or valves, or others similar in their most important features, has every exploding boiler been furnished since the use of steam-engines became general, a fact which would alone prove, that where real danger exists, and when they ought to fulfil their intention to most purpose, they are of little or no use. Indeed, it may be confidently asserted that their utility as safety-valves does not in any great degree extend beyond that of indicating to the attendant any increment of pressure that may take place, and giving him the power of blowing off at intervals what amount circumstances may require. Their inutility as self-acting protectors at the critical junctures of neglect and danger would appear evident, and the fault lies most probably in some defect in their construction. It may be said, that by making them of larger diameter, greater security might be afforded; but this is inconvenient, and it is, moreover, quite possible that a defect may exist which is common to large and small valves. Now, it seems highly probable that a most serious defect does exist, and lies in this simple fact, that the plate constituting the valve is made flat, or hollowed out on the under side. It cannot be doubted, on due consideration, that this form of valve is bad; for this simple reason, that any fluid in motion meeting with an obstacle at right angles to its course, must reverberate upon itself—as is exemplified in Mongolfier's hydraulic ram, and in the bursting of pipes by the reaction of water on a sudden stoppage. Thus it is evident, that when the valve is open, the greater part of the steam which rushes to its exit will strike against the under side of the valve-plate, and be thrown back in an opposite direction with great velocity, forming thereby an opposing current to the particles of steam which immediately follow.

Fig. 2.



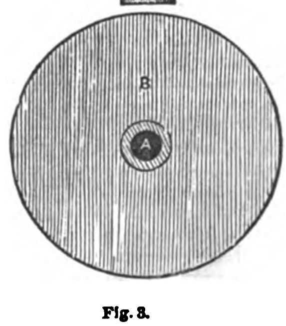


Fig. 3.

Now, that the evil effects of this action are more serious than might be at first imagined, may be shown on reference to a small well-known philosophical curiosity, first noticed by Clement des Ormes, but originally discovered, we believe, by Mr. Roberts of Manchester. Fig. 2 represents an elevation, partly in section, of a small tube, A, having attached to it at one end a flat plate, B, C, being another loose plate of the same diameter. Fig. 3 is a plan corresponding. The top side of B, and the under side of C, ought to be both level, and somewhat accurately fitting when placed together. If we now hold the in-

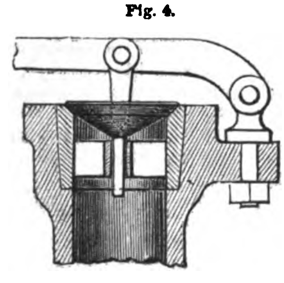
strument perpendicularly, having placed the plate, C, on the top of B, and blow through the lower end of the tube, no force of blast which can be exerted will be able to remove the plate, C, from its position.

The fact is certain, and the reason has been variously explained; although, however, a true and exact solution is difficult to arrive at, it seems most likely that the action which takes place, is very nearly allied to the following:—The air being projected up the tube, A, strikes forcibly in the first instance against the top plate, C, tending to lift it from its state of rest, which it certainly does to some extent; no sooner has this taken place, however, than the air recoils upon itself, and prevents the escape of any but a very small quantity. This action of the air in the tube is either then repeated by a series of pulsations, or it resolves itself into two opposing currents, the downward one of which, having only slightly less velocity than the upward one, nearly closes the passage into the annular space between the plates, admitting only a very minute portion of air. In the meantime the plate, C, when first struck by the air in the tube, rises from contact with B so suddenly, that the air from the exterior has not time allowed to rush in between the plates to fill up the vacuum, so that the pressure of the atmosphere on the top immediately forces it back to its former position, or rather till it meets with an elastic stratum of air, and the combined force of the upward blast; it then rebounds as suddenly as before, and continues to repeat this action by a series of minute and almost entirely imperceptible pulsations. It would seem, then, that the quantity of air escaping into the annular space by even the most forcible blast is so extremely minute, that the plate cannot rise far, before the pressure of the atmosphere on the top becomes greater than the pressure in that space, and the force of the upward current on its limited area, combined.

Precisely similar, in all respects, is the action of a safety-valve, except that its tendency to ascend on pressure being exerted below, is not retarded to the same extent as in the instrument described, by reason of its annular space bearing a much smaller proportion to the whole area of the plate. That it is, however, in some degree retarded and prevented from rising to its due height, may be gathered from analogy, and experience appears to confirm this notion. It would not be easy, from the data which we possess, to fix the point at which a valve of a given area and configuration ought to stand under a given pressure; but it is certain that observation points out that they never rise very high, even under the greatest pressures. Granting, however, that they rise to a sufficient height—which they seldom or never do—as to give an annular area for the escape of the steam equal to the area of the passage leading thereto, still the effect noticed with regard to the air in the pipe must hold good here also; in fact, the amount of steam which the area of the passage ought to give, does not escape. The fury of the steam is expended by being thrown back in antagonism to itself, and in forming an effectual barrier to free egress, those particles which are so successful as to find a passage out, making their escape into the atmosphere with a loud and intolerable noise. We are well aware, as has been before stated, that the recoil of water in a pipe, on an obstacle at right angles to its course, exercises a very great retarding influence on its flow, and it is much to be apprehended that the more elastic the fluid, the greater the evil.

Having thus pointed out a defect which, simple as it may appear, there is every reason to believe results in rendering the safety-valve no safety-valve at all, it remains to find a remedy. This is so simple, and so obviously efficient, that it needs no further recommendation than merely to state, that it consists in making the under side of the valve of such a shape, as that the particles of steam, on striking it, shall be directed in their recoil, immediately towards the opening. Fig. 4 will give a rough idea of such a valve; and it may be stated, in confirmation of the self-evident superiority of such a construction, that pump-valves of this description, which the writer has tried, are, so far as may be judged from practical and inaccurate experiment, more effective in their delivery, less noisy, and better in all respects, than the ordinary plate valves.

Fig. 4.

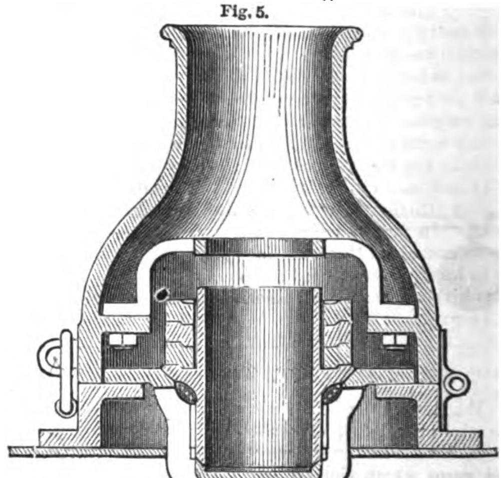


There are, however, other minor defects in safety-valves. One of these frequently prevails in the weighted lever-valve, and is illustrated, with some exaggeration, by the dotted lines in fig. 1. In consequence of the point at which the lever here bears upon the valve—being placed so much above the part which guides it—and the often ill-considered position of the fulcrum, *a*, it is evident, that before the valve can rise any reasonable height, a large amount of resistance must be given to its further progress, by its being forced into an angular position, thereby jamming the spindle in its guide, and adding an undue amount of friction. Some valves, it is true, being carefully constructed, and with due attention to their proper action in this respect, are not open to this objection; but it is to be feared that this applies only to the minority of cases. The risk, however, if not entirely removed, is very greatly diminished by the arrangement which results from the form of the valve, fig. 4, where the bearing point of the lever is considerably lower than the seat of the valve.

Another imperfection may be noticed in a common application to this species of safety apparatus; namely, the ordinary spring balance. Although this is, in other respects, a neat and convenient contrivance, it has the serious defect of giving no clue to the actual pressure in the boiler at the time when steam is blowing off. For instance, supposing the valve to have been screwed down to a given pressure—at the instant of the valve's first rising, that pressure will be indicated on the scale with tolerable correctness; but on its rising, and thereby lifting the lever, to the smallest extent further, the spring becomes immediately stronger by tension, while inversely, from the beforementioned causes, the tendency of the valve itself to rise, becomes weaker, and that to an unknown amount. The deceptive consequences of this are obvious, and need no further explanation; but although the matter may be made light of, as it is certain that a boiler may explode when its safety-valves are blowing their utmost, so it is possible that, under these circumstances, a spring balance, instead of acting as a protector, becomes the very reverse.

Let us now see what are the requisites of a good safety-valve. They may, we think, be stated to be simply these:—1st, That it should be of such a form as to allow of the freest egress of the steam; 2d, that it should be capable of rising (by pressure) any limited height, freely and without sticking;* 3d, that it should be of dimensions large enough to relieve the boiler of its pressure, even under the most unlooked-for rapidity of evolution of vapour. The first of these requisites is, in some degree, fulfilled by the arrangement shown in fig. 4; the second also partially, although it would be better to discard the lever altogether, and substitute weights placed immediately over the axis of the valve: as this, however, would be inconvenient and awkward in high-pressure boilers, and as, in order properly to fulfil the last requisite, any method of weighting would be extremely clumsy and intractable under ordinary construction, we may submit the contrivance shown in figs. 5 and 6, as one likely to answer the purposes of a safety-valve, to a fuller extent, than any that has yet been in use.

Fig. 5.



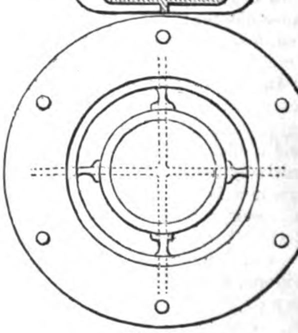


Fig. 6.

It will be seen, on reference to the vertical section, fig. 6 being a plan of the seat, that this valve is annular, and has two concentric bearing-surfaces, so that, when lifted, it allows the steam to escape through two openings. The inner opening

* It has been asserted that cases have been known of valves getting fixed in their seats through oxidization. It is beyond belief, however, that a brass valve can from this cause become set so firmly as to resist pressure with greater obstinacy than even the boiler itself. It is much more likely that the assertion has been invented as an excuse for some gross neglect or abuse; besides, a properly constructed valve will be too frequently on the move to run the chance of rusting fast.

may be made of any diameter; and the annular area, on which pressure is exerted, is thus limited to any amount, by which means the whole can be conveniently weighted in the manner shown, and without occupying much bulk. Its advantages in this respect are very great, inasmuch as a greatly increased diameter may be used without injuring its sensitiveness, or increasing its unwieldiness. Exclusive of this, it enables a much greater amount of steam to escape for a given diameter than the ordinary one, and none of the phenomena noticed as appertaining to the latter can here take place, provided a proper form be given to the under side, between the outer and inner seats. This form is, perhaps, shown imperfectly—that marked by the dotted lines being better.

Fig. 7 is a valve of the same construction, but possessing this difference, that the central opening, instead of having straight sides, is contracted towards the mouth; the purpose of this modification being, that, besides allowing more room for weights, it gives the valve a tendency to rise more freely under great pressures, by presenting an additional area to the action of the escaping steam when the valve is partially raised from its seat.

Fig. 7.

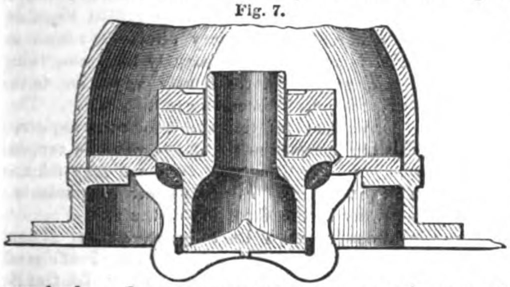
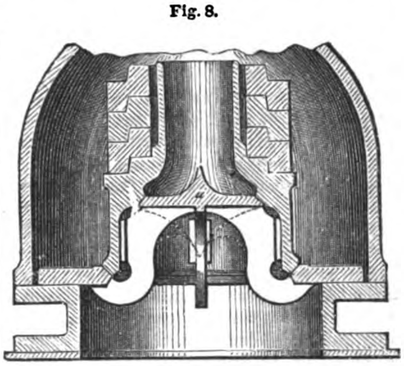


Fig. 8 is another modification of the same valve; the position of the seats relatively to one another being reversed. This form is perhaps the most convenient, and the section of the upper plate, *a*, may advantageously form a curve downwards, as shown by the dotted lines in the sketch.

Fig. 8.

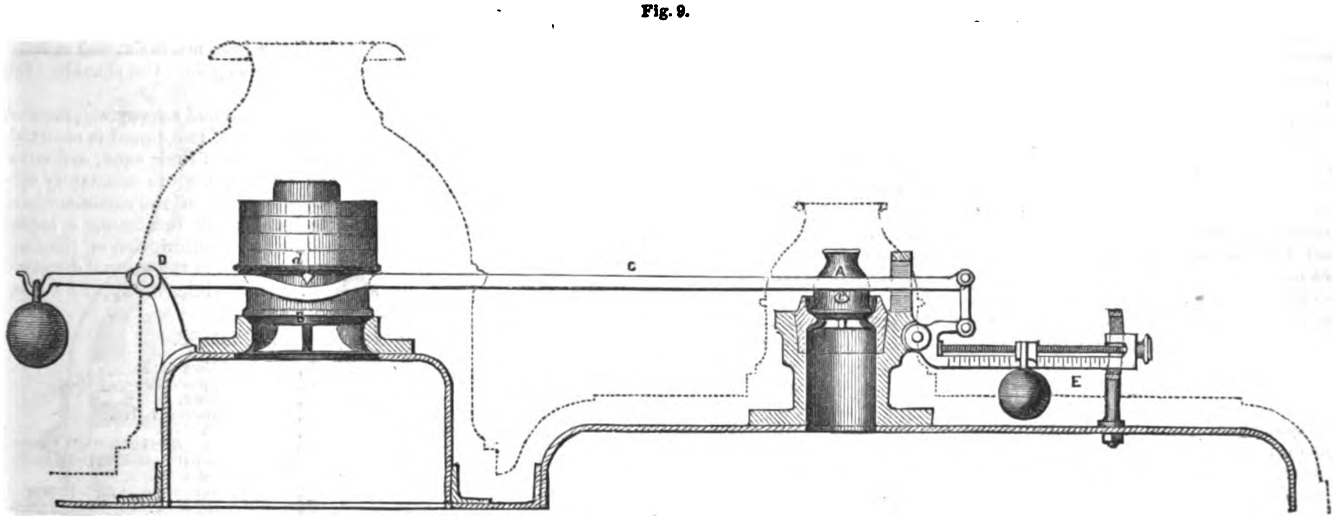


The form may be modified to some extent, and the best must be the result of experiment; but with this construction there exists apparently no objection whatever to the employment of valves of such increased dimensions as to discharge rapidly even the most dangerous evolution of steam, or by whatever other name the gaseous originator of pressure may be designated.

In conclusion, we may suggest a combination and application of the principles above described, constituting a safety apparatus, which, however imperfect, may be confidently asserted to be superior to that commonly used in locomotives, and may be applied with advantage to all boilers.

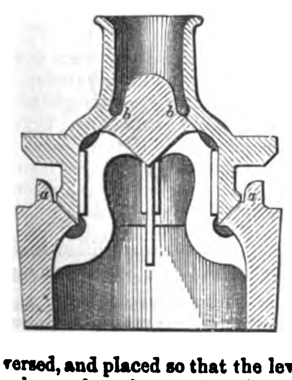
It consists of an arrangement of two valves, fig. 9; one of which, A, is of ordinary dimensions, while the other, B, is much larger, and is regulated by its weights so as to rise under a somewhat greater pressure than A. The two valves are similar in their principle of construction, being

Fig. 9.



the same as that shown in fig. 8, but have this difference, that the smaller one, A, which is also shown in enlarged section in fig. 10, has the edges of its two seats, at *a* and *b*, raised upwards and slightly inclined; the intention of this addition being, that when the valve is first lifted, only a small portion of steam may escape, in order to insure its rising higher as the pressure increases. The larger valve, B, is weighted with a series of metallic rings, as before described, and the smaller one, A, by a combination of levers. Of these, the upper one, C, having its fulcrum at D, beyond B, and resting on knife-edges, *c*, on the valve, A, is connected by links with the lower one, E, the latter being graduated and weighted in such a manner that the weight can be traversed backward and forward by a screw, so as to indicate any pressure required. The valve, B, has also knife-edges, *d*, but reversed, and placed so that the lever, C, may bear upon them only when the valve, A, has risen a given height. It will be understood, then, that on

Fig. 10.



the pressure in the boiler becoming greater than circumstances require, the steam first escapes at the valve, A—B never rising till it becomes dangerously strong; but the more effectually to insure the proper action of the latter when this does take place, the valve, A, rising higher under the increasing pressure, lifts the lever, C, till it bears upon the knife-edges, *d*, and relieves B of a portion of its weight. Thus, when the attendant desires to ascertain that the valve, B, is in proper working order, all he requires to do is to screw the weight back, until the valve, A, communicates sufficient pressure to the knife-points, *d*, when the valve, B, begins to move, and he sees that all is right by the escape of steam. This can be done although the valve, B, should be locked up, and out of the reach of the attendant, while, at the same time, it cannot be affected by any undue weighting of the levers, C and E.

For knife-edges, small steel rollers may perhaps be substituted with advantage, and additional delicacy of action might be secured by counterbalancing the weight of the two levers, as shown.

More important improvements might possibly be suggested, more especially such as tend to simplification, which would render the apparatus more complete and effective: in the meantime, if it be allowable to decide, *à priori*, that the foregoing principles are correct, there seems little reason to doubt that safety-valves may yet be constructed which shall be worthy of their name, or, in other words, that steam-boilers are capable of being rendered as harmless as a tea-kettle, whose lid is not soldered hard and fast.

MECHANICAL APPLICATIONS OF SCHIELE'S ANTI-FRICTION CURVE.

(*Illustrated by Plates* 81 *and* 82.)

The elegant invention of the "Anti-Friction Curve," patented sometime ago,* by Mr. C. Schiele of Oldham, near Manchester, has gradually worked its way into the details of the workshop, and has established its claim upon the mechanical engineer for employment, wherever working surfaces have to sustain pressure in the direction of their axes of revolution. The simplicity of this modified form of surface, and the self-evident improvement which it introduces throughout the entire range of mechanical construction, must soon effect a thorough change in our workshop practice, as regards the form of all details, working under the circumstances just mentioned. By it we obtain a definite rule for the construction of rubbing surfaces of the rotatory portions of machinery, by which wear is regulated to a uniform action, whilst the consequent friction is reduced as far as form appears to be capable of effecting its diminution. We have, therefore, adopted the name of "Anti-Friction Curve," in describing its applications to mechanical purposes; but, mathematically speaking, we should term it the Hugenian, or equi-tangential tractory.

$$\text{Equation: } x = m, \log. \frac{m - \sqrt{m^2 - y^2}}{y} + \sqrt{m^2 - y^2}$$

Plate 81 exhibits a series of theoretical curves, by means of which the practical delineation of the curve may be explained. Plate 82 contains a set of 25 figures of practical applications of the curve, which deserve the study of the mechanic. Fig. 1, on Plate 81, is a theoretical figure, showing the peculiar form of curve, and may be supposed to be the footstep journal for an upright shaft. To delineate it, the little instrument shown in figs. 2 and 3 is used. Fig. 2 is a plan of the instrument in the act of drawing a curve, and fig. 3 is a corresponding side elevation of it—the apparatus being constructed in relation to the property of the curve, as having equal tangents. The small wooden slider, *a*, being drawn along the fixed straight edge, *b*, the pen, *c*, filled with ink, describes the curve.†

Whatever kind of surfaces may be used, the wear increases with the distance from the axis of revolution, and decreases to nothing towards the centre or axis; therefore, such rubbing surfaces ought to be constructed in such a way, as to be equally affected in any point by the different degrees of friction, as shown in fig. 4. Here two equal curves are shown, the one, *a e*, representing a section of a rubbing surface as first constructed; the other, *a' e'*, as if the same were worn out to the extent by which they are sundered. The tangents are equal, *a b*, *c d*, *e f*. The distances parallel to the axis are equal, *a a'*, *d d'*, *e e'*.

The distances between parallel tangents, *a a'*, *g h*, *i k*, are decreasing, or the amount of wear at those places, in the same ratio as the radii of their touching points *a*, *d*, *e*.

In all surfaces constructed on any other principle, as the disc, cone, or sphere, the parts wear away quicker from the centre, and therefore, being released from their fair share of strain, the slower wearing parts nearer the centre have to bear an undue pressure, increasing until the particles of the material are too weak to sustain such a pressure, and become crushed, and spread over the whole of the rubbing surfaces, producing such a friction as to cause wear and heat, varying in degree according to the *form of the surfaces*, the *pressure*, the *nature of the material*, and the kind of *lubrication*. Hitherto, no one has properly investigated the form of faces, or the nature of friction would have led at once to the discovery of one particular form as the best and natural one; for this cannot be for a moment doubted, when we know that different forms show different frictional results. Extent of surface, nature of material, and lubrication, have been frequently under extended investigation, and have received great improvements, but Mr. Schiele has been the first observer to give us a definite rule to settle the question.

In *extending* the surface, or *increasing* it, we are met by a loss of motive power, whilst the injurious effect of unequal wear is only delayed, not overcome. The extent of surface, where the anti-friction curve is applied, is definite, and only so large as not to be injuriously affected by the strain upon it, whilst it allows of the use of the smallest diameter, and bears side strain closer to the centre of revolution than any other form. It is true, that the nature of the material is a very essential point; but it is also true, that whatever advantage may arise from this can only delay bad wear. Lubrication has always been a difficult subject, and not unfrequently both surface and strength are partially sacrificed to effect and improve it; but in the new curve this is obviated, as the surfaces are kept so close that they serve as valves, and may be lubricated by pressure, so as to keep them well greased. For want of some definite rule for the formation of rubbing surfaces, as they have all along existed, we are prevented from comparing the relative amount of friction of the old and new plans; and the question so generally put, as to the real reduction of friction, can only be answered by giving the amount of the friction of the surfaces as at present formed, too uncertain to be easily determined, and continually increasing to a maximum; the new curve, on the contrary, giving a constant decrease. In the wear of pivots, and centres of lathes, it is found that conical surfaces under neglected use assume the form of the new curve—proving the correctness of the new theory. For an example of this wear we may refer to fig. 5, on Plate 81, where two pieces of chalk fitted with conical bearings, soon assume the anti-friction curve, marked by the dotted lines, on being rubbed against each other. This is very obviously shown by actual experiment, if the trial is carried on sufficiently long, care being taken to remove small particles of sand frequently appearing in the chalk and scratching the surfaces, and to brush away the dust.

A certain rule gives the correct part of the curve for resisting given strains efficiently, and this is, to commence the curve with its tangent at a right angle to the strain. To illustrate this, we may take as instances the pivots of upright shafts. Fig. 6, of our diagrams, is a pivot fitted for a pressure entirely in the direction of the axis of revolution. There the curve commences with its tangent, *a b*, at a right angle to the axis, along the full scope of the curve. Fig. 7 is a pivot with an oblique strain, its tangents, *c d*, commencing at a right angle to it. Fig. 8, again, shows that when the strain approaches more to a right angle to the axis, the curve also approximates more and more to a cylindrical form, which is the form in general use for resisting a strain acting at a right angle to the axis. Compound strains allow of reduction to one of the above named strains; therefore, this rule applies also to them. Separate provision is required for strains acting at intervals separately, as the pressure of cart-wheels against the shoulder of an axle, fig. 9.

The accuracy of instruments for astronomical and surveying purposes, and machines for dividing, or wherever nicety of movement is essential, depends, in a great measure, on the correctness of their axes; and scientific men in the habit of using such instruments are constantly subjected to inconvenience, from the irregular wear of the common forms. Next month we shall follow up the subject by furnishing a second sheet of the applied curves, with an illustrative description of the practical effect of the improvement, in its adaptation to the several divisions, or distinct classes of rubbing surfaces. Meanwhile, we append a tabulated

Reference to the figures in Plate 82.

1 & 2,	Self-acting feed regulator for Steam Boilers.	14,	Feed Cock for Pump.
3,	Safety Valve.	15,	Oil Cup and two-way Cock.
4,	Lock-up Safety Valve.	16,	Stop Cock.
5,	Stop or Junction Valve.	17,	Equilibrium Valve.
6 & 7,	Glass Water Guages with a three-way Cock.	18,	Pump Valves.
8,	Steam Whistle with four-way Cock.	19,	Do. for Hydrostatic Presses.
9 & 10,	Guage Cock.	20 & 21,	Lloyd's patent double Cylinder Expansion Valve.
11,	Overflow Valve on Feed Pipe.	22,	Bib Cock, screwed for iron pipe.
12,	Steam Valve.	23,	Tapping Cock.
13,	Sludge or Blow-off Cock.	24,	Glass Tap.
		25,	Glass Stopper.

NOTES ON THE GREAT EXHIBITION.

DOLLOND'S ATMOSPHERIC RECORDER—CONSTABLE'S COMPENSATING FLY-WHEEL—TAPLIN'S TELESCOPIC STEAM-BOAT FUNNEL—HOSKING'S COMPOUND ANNULAR HYDRAULIC VALVE.

Mr. Dollond, the eminent optician, has erected a small wooden house in the enclosed area, outside the extreme western end of the building, to contain his highly-elaborated "Atmospheric recorder, or self-registering apparatus for the various changes of the barometer, thermometer, hygrometer, electrometer, pluviometer, and evaporator, and of the force and direction of the wind." This is the most complete and efficient instrument which has yet been contrived. It consists of a rectangular frame, of about two feet by three feet six, firmly supported on four pillars. Near each end of the frame is a roller of one foot in circumference, to one of which is attached an eight-day clock, to drive it round once in 24 hours. The roller at the opposite end of the frame acts as a rest for carrying the register-paper to a platform in the middle of the frame. Near the end of the frame, which is placed towards the north, is a strong bar, upon which all the fulcra of the indicators, or markers, are placed; these markers, being arms of a foot long, with spring points at their ends, for the barometer, thermometer, and hygrometer, are struck down

* For earlier notices of this very important invention, see pages 50 and 82, Vol. II.; and 252, Vol. III., *Practical Mechanic's Journal*.

† For a fuller description of the form of this instrument, see p. 50, Vol. II., *Practical Mechanic's Journal*.

THE ANTI-FRICTION CURVE.

C. SCHIELE. *PATENTEE.*

OLDHAM. *NEAR MANCHESTER.*

Fig. 1.

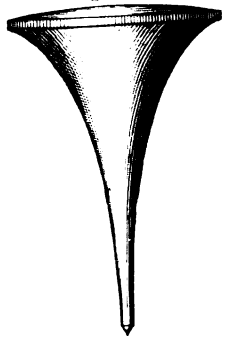


Fig. 4.

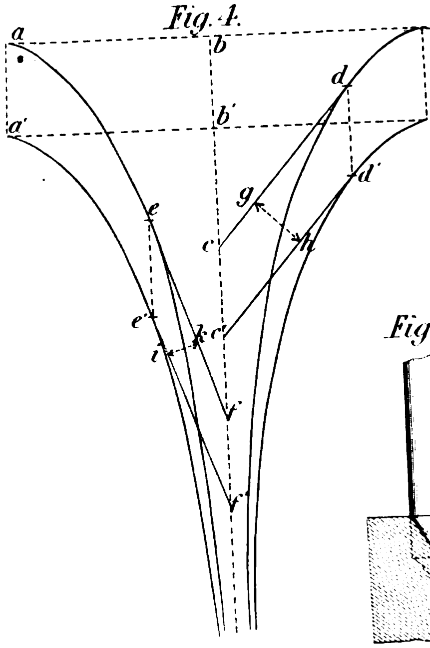


Fig. 3. *Fig. 2.*

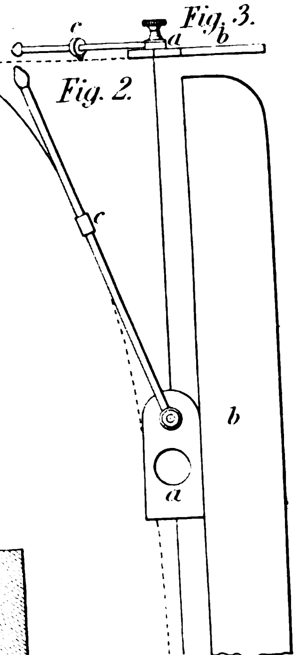


Fig. 5.

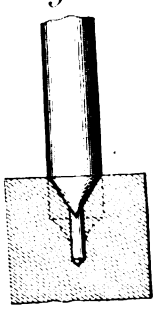


Fig. 6.

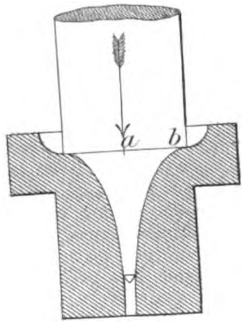


Fig. 7.

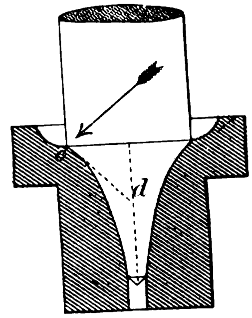


Fig. 8.

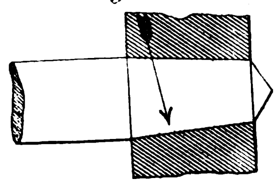


Fig. 9.

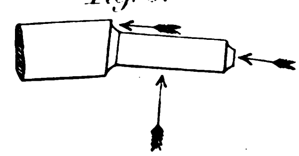


Fig. 10.

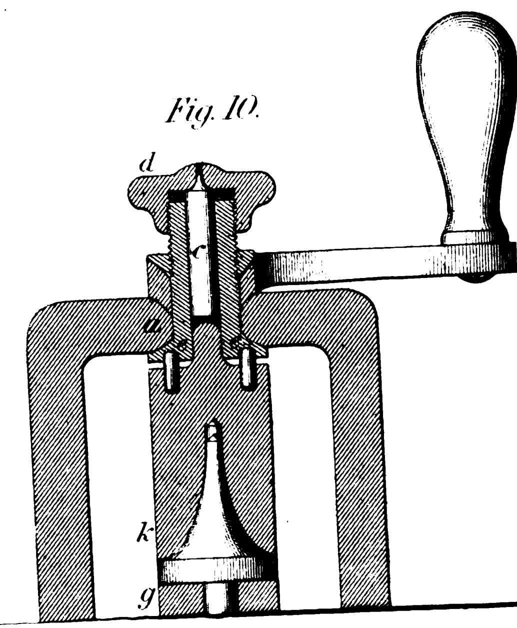


Fig. 11.

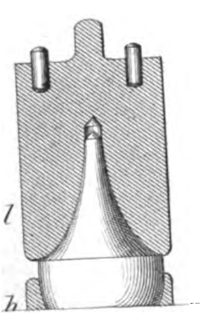
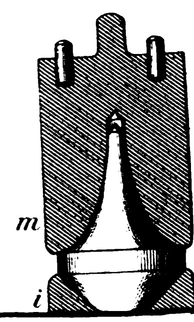


Fig. 12.



to the paper every half hour by a falling lever. For the electrometer, rain evaporator, force and direction of the wind, ever-pointed pencils are used, making a continuous mark upon the paper. Each indicator has its proper scale set near the line of the registering points and pencils, so that the last marks may be compared with their respective scales, with reference to the time at which the indication took place.

On each side of the frame is a marker for time, governed by a wheel attached to the clock roller, which, by a lever and inclined planes, are made to register the time correctly at each half hour, and the sixth hour more strongly, for convenience in counting.

The barometer is on the principle of a syphon of large bore. Upon the surface of the mercury in the shortest leg, is placed an accurately counterpoised float, communicating by a thread and pulley with the marker, the indications being given on a scale of three to one.

The thermometrical arrangement consists of ten mercurial thermometers of peculiar form, placed on an elevated stage, and having a corresponding indicator. They are suspended on an extremely delicate balance, the motion of which, due to the variations in the expansion of the mercury, is communicated to the indicator; they are screened from the wind by perforated zinc plates.

The hygrometer indicator is acted on by a slip of mahogany, cut across the grain, and placed outside the observatory, in a tube open at both ends. This slip of wood was prepared by placing it in a cylinder of water, suspended from its upper end, with a weight attached below, until it was found, by repeated examinations, that it was completely saturated, its length being increased to its full extension. This length was then referred to an accurate scale, the wood being placed near a stove pipe with the same weight hung to it, until it contracted to its utmost amount. The difference between these two results being then taken, the scale was formed accordingly. It is suspended and weighted, with full power to act on the indicator, quite free from the action of the sun and rain, and shows, upon an open scale, every hundredth of its extremes of dryness and moisture. This plan of hygrometer is the invention of H. Lawson, Esq., F.R.S., who has one in his possession, made for and used by Franklin, and which is still an accurate indicator.

The arm of the electrometer for thunder-storms and electric changes is worked by a well-insulated conductor, placed in an elevated position, and having a wire brought down to an insulator on the top of the observatory, and thence to a standard, through another insulator, to a metal disc, between which and a spring there is a moveable disc, attached to a glass arm. In connection with this arm and disc there is a pencil, carried forward to the line of indication. The spring is fixed to a standard, at about three inches from the first disc; to this a wire is attached, and carried into the earth. When a cloud, charged with the electric fluid, comes within the range of the conductor, the moveable disc begins to pass slowly from the first disc to the spring, discharging, each time, a portion of the electricity, and increasing in rapidity of motion, until the discharge of the cloud by lightning takes place. It then falls back to the first disc, remaining still until again called into action in a similar manner.

The pluviometer indicator is in connection with a receiver, which has an area of one square foot, and is elevated clear of anything that might interfere with the fall of the rain. From this external receiver, a pipe conducts the water to a cylindrical vessel beneath the apparatus. A float in this cylinder is in connection with a series of inclines, contrived so that each shall represent an inch of rain. As the rain falls, the inclines pass upwards with the float, acting on the end of the indicator, which is thus moved over the required distance on the paper, showing, as it proceeds, the result of each drop to the hundredth of an inch in superficies, until an inch is registered. It is then discharged, and returns to the zero of the scale for another inch.

The evaporator indicator, is actuated in connection with a square foot receiver, supplied with water from a larger vessel, being connected by a pipe beneath. From this connection the movement is conveyed to the indicator, from a float in the larger vessel. The evaporator is covered with a plate of glass, set at an angle to keep out the rain, and yet allow of free evaporation.

The anemometrical indications are taken from a vertical board of one foot area, kept in opposition to the exact direction of the wind by a surmounting vane. This portion of the apparatus is nicely balanced to avoid all friction, and is in connection with a chain passing over a pulley with weights suspended to it. The chain passes down the tubular vane shaft, near the foot of which it is attached to a set of inclines, acting upon an indicator. When the board is acted upon by the wind, its motion elevates the weights, and moves the pencil on the scale, registering the weight lifted, in ounces and pounds avoirdupois. A little pencil, at the same time, indicates the direction of the wind by the turning of the vane. The paper for the registration diagrams is specially made for the purpose, so that a difficulty long felt by meteorologists, in securing a suitable kind, is now removed.

Such of our readers as are interested in instruments of this class, may refer back to our plate 53, of "Bryson's Tidal and Meteorological Clock," at page 136 of our second volume.

In the collection of mechanical models, is a curious one by Mr. W. Constable, being what he calls a "compensating fly-wheel." It is intended to perfect the action of the ordinary fly-wheel in its office of accumulating the irregular impulses of the reciprocating engine, and turning them into a uniform power. The common fly-wheel is, indeed, usually described as effecting this, pretty nearly to perfection, from its aptness in gathering up all contributions of power in virtue of its inertia; but it is plain, that as it is fixed unyieldingly upon its shaft, whatever irregularities occur, whether from variations in the steam pressure, or in the resistance of the driven machinery, they must be communicated, to a greater or less extent, through the wheel to the machinery. Every one knows how palpable this is with a light wheel, as being more easily affected by the disturbing impulses; the remedy has therefore been sought, with but partial success, in increased weight.

As no increase in weight can fully correct these inequalities of motion, Mr. Constable has given us, in his model, a hint of another system. Instead of keying his wheel firm on the shaft, he places it loose, and connects it to the moving power through the medium of springs. Alongside the wheel is placed a boss, with three radiating arms, extending nearly to the periphery of the wheel. This boss is keyed on the driving shaft, and to the end of each arm is attached a strap of leather, passing over a pulley set on a stud in the rim of the wheel. This stud passes through the rim, and its opposite end carries a second pulley to the periphery of which, a strap is fastened and passed from it to the outer end of a helical spring carried on the side of the fly-wheel arm. It is then clear, that if the moving force becomes accelerated, the three arms fast on the shaft will act in virtue of such acceleration upon the fly-wheel springs. These springs will absorb the surplus power, or, in other terms, the surplus velocity, so as to prevent the acceleration from acting at once on the wheel to urge it beyond its speed; whilst, on the contrary, when the moving force becomes weaker, or the arms fail in speed, the reaction of the springs gives out the surplus power formerly stored up in them, and the original relation between the impelling arms and fly-wheel is again resumed. In this way all oscillations of force will be conveyed through the springs, without in any way interfering with the fly-wheel.

But there is yet something more to be done. If both the strap pulleys are of the same diameter, the connection of a fluctuating into a constant force would still be imperfect. One of the pulleys has its periphery formed to what the inventor terms the *isodynamic curve*, so that the lever of resistance within it, through which the impelling arm acts by the strap, increases as the impelling force increases. We are not aware that this scheme has yet received any practical trial; but as Mr. Constable professes not merely to improve, but to perfect the action of the reciprocating engine, we presume it will shortly be heard of amongst practical engine builders.

Mr. R. Taplin, of H.M. Dock-Yard, Woolwich, contributes a "Model of a telescope funnel or chimney for marine boilers."

By this design, it is intended to strike the chimney and waste steam-pipe of any steam-vessel, from the highest elevation, level with the upper deck, or even below it, if required. By this means the deck may be freed from such encumbrance, at the particular times when, by dispensing with the usual height, neither the working of the engines nor the boiler will be prejudicially affected; whilst the vessel, having full command over her sails, may use them instead of steam to greater advantage than has hitherto been accomplished, the chimney being entirely removed, and not partially so, as is the case with all steam-ships as now fitted. Prior to this novel plan, the chimneys of steam-vessels have been so constructed as to admit of but one sliding part, which, when struck to the lowest possible position, generally presents an unavoidable altitude of many feet above the deck, thus adding to other disadvantages that of presenting resisting surface to the air when under sail.

It is presumed that the screw-ship would find this compound sliding-funnel a desideratum, particularly when not only an unsightly funnel, but even masts, rigging, and their appendages, might be considered inexpedient to be retained, and when the hull only should be seen floating on the water, in order to achieve some important enterprise by approaching an object unobserved. In such case, a smokeless coal or coke might be used, the products of combustion escaping from the chimney, though struck level with the deck, and being perfectly harmless to the crew of the vessel.

The compound funnel may be composed of any reasonable number of

sliding parts, and yet the entire series may be raised or lowered simultaneously, in less time than the ordinary single telescopic funnel, and effected by one simple mechanical operation. This will be easily comprehended by an inspection either of the model in the Exhibition, or the accompanying engravings. Fig. 1 is a side elevation of the funnel, and waste steam-pipe when elevated to their full height, the upper-deck being shewn in longitudinal section. Fig. 2 is a corresponding view at right angles to fig. 1, or looking on the front of the funnel, which is lowered down to the deck-level, the deck being in transverse section. Fig. 3 is a plan of the funnel.

Fig. 1.

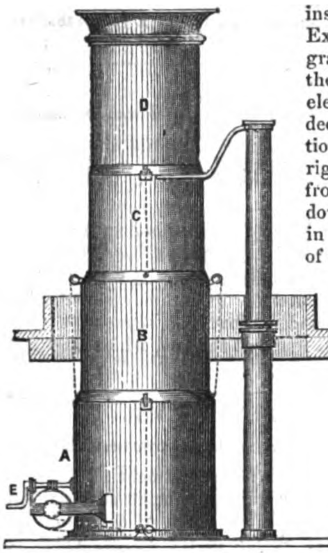
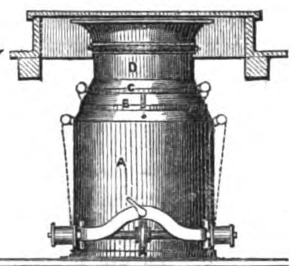
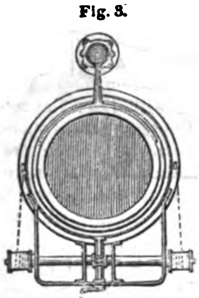


Fig. 2.



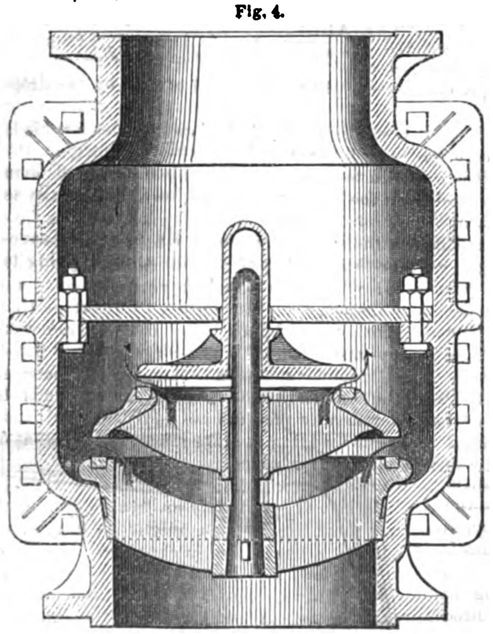
Each part being separate, is marked A B C D. The outer case, A, has two guide-pulleys fixed diametrically opposite to each other on its upper edge. Over these a chain passes, one on each side; one end being secured to the lower end of the next sliding part, B, and the other end to the barrel of the hoisting apparatus. The second section, B, has also two pulleys on its upper rim, with a chain passing over them, secured at one end to the lower extremity of the third section, C, and the other end to the top of the first section, A. The third section, C, has also pulleys similarly placed, to guide the chains, one end being fastened to the extreme end of the highest section, D, and the other to the top of the division, B.

Fig. 3.



It is obvious that, to raise these several pieces, it is only requisite to haul the chain applied to the hoisting apparatus, or to turn the handle, E, and the whole system is immediately put into motion, to advance or recede, as the case may require, not in succession, but simultaneously; and when the funnel is lowered to the extreme depression, the top is brought down in a line with the upper deck, or lower if requisite.

Fig. 4.



1-16th.

Mr. Taplin's arrangement possesses much ingenuity, and very completely effects the desired object of getting the funnel totally out of harm's way.

Mr. R. Hosking, of the Perran Foundry, Cornwall, has an excellent specimen of a "valve applicable for large pumps, divided into several parts, so as to avoid the risk of breaking by concussion, the different parts shutting in succession." Our engraving, fig. 4, is a vertical section of this valve in its open state; the lifting portions are in this example two in number, the water passing through their annular spaces, as indicated by the arrows. In this way, not only is the water-way increased, but the valve action is made almost noiseless, and quite free from objectionable concussion—important advantages, which have hitherto been quite unattainable in one valve, because, to reduce concussion, the water-way has always been narrowed. The water in Mr. Hosking's valve gets clear away near the centre of the column; and as the valve-lift is always in proportion to its area, the system of division constitutes each section a separate valve, shutting at different intervals, and the lift is thus so reduced that the shock in dropping is scarcely perceptible. Cornish engineers have taught us many lessons in mechanical engineering, and this one on pump-valves is by no means of the least importance.

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FURNACES AND PREVENTION OF SMOKE.

W. M'Gavin, *Glasgow*. *Enrolled July* 29, 1851.

The patentee states his invention to consist of "certain modifications or arrangements of boilers and furnaces, or fire-places of various kinds, for the purpose of producing a superior combustion and economy of fuel, and a better application of the heat, together with the prevention of the formation of smoke." His explanatory modification is represented as applied to a cylindrical boiler with double flues, but with a single furnace for both, divided down the centre, longitudinally, by a water space extending from the fire, down nearly to the bridge, and communicating, at top and bottom, with the water in the boiler. In other words, there are two short cylindrical flues, each containing grate-bars and forming two distinct furnaces, until they approach the end of the grate-bars, at which point the outside of each flue is curved or turned inwards, the lines of grate-bars being fitted to correspond with such curvature. This portion forms the confluence of the two flues or furnaces, as the termination of the water-space leaves a clear space across from side to side of the furnace. The throat formed by this confluence is immediately over the bridge, behind which the sides of the flues again diverge, either by straight or curved lines, each flue being again contracted by a short conical portion, to bring their respective areas to correspond to the two separate long flues, running from the bridge to the termination of the boiler. These long flues are divided by a central water-space, the front end of which is rounded off where the combined gaseous currents impinge upon it. At the end of the boiler they open into a transverse flue, the ends of which cross flue respectively terminate in an external longitudinal flue, extending along nearly the whole length of the boiler, until they open by short descending portions into the front end of a bottom central flue. This last flue runs beneath the boiler front, until it terminates by an upward bend in the main horizontal flue going direct to the chimney. Boilers of this class may have both furnaces fired, either simultaneously or alternately, the flame and gases passing from each furnace in two separate currents, and being deflected inwards into one, by the two inclines at the front of the bridge. Any unconsumed gases are thus more effectually intermingled with the air

passing in through the grate-bars, and with whatever flame and heated matters may be present. This condensed current thence passes through the contracted throat or flue, again dividing into two currents, and passing along the separate flues as before stated.

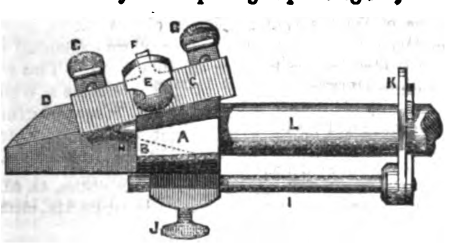
Mr. M'Gavin states that the same effect may be produced by various arrangements of expanding and contracting surfaces, the peculiarity of his system being the more effectual intermingling the gaseous current by the general arrangement and form of the furnaces and flues. Several furnaces are now working on Mr. M'Gavin's principle, with very economical results, and barely producing any perceptible smoke.

REGISTERED DESIGNS.

PENCIL CUTTER AND SHARPENER.

Registered for Messrs. A. Marion & Co, (*Papeterie Marion*), *Regent Street, London.*

The object of Messrs. Marion's clever little instrument is to give increased facility in sharpening or pointing crayons and pencils of all kinds.



Our engraving represents a side elevation of the tool in the act of sharpening a pencil. A projection, A, is formed on the side of a piece of metal, sufficiently large to allow of a conical aperture, B, corresponding with the required cone of a pointed lead pencil. One side of this projection is slotted to receive the cutting edge of the small knife, C, which is attached to the inclined portion, D, of the metal block by the screw, E, passing through a slot in the knife. A short projection, F, is formed upon the knife for the convenience of adjustment, and when set, it is held in position by the two set-screws, G. A small handle is screwed into the block at H, from behind, for the convenience of holding the instrument when in use, and the end of this handle is hollowed to receive the small projection, F, on the knife, C, for the facility of holding it when detached for the purpose of sharpening the edge. An adjustable guide, I, is secured by the pinching-screw, J, by one end, beneath the block, and is furnished with two arms, K, jointed on to the end of the rod of the guide, for embracing the pencil, L, during the cutting operation.

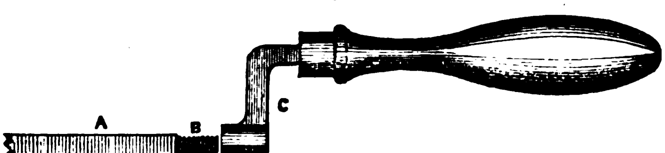
In using this instrument, the pencil is simply passed between the two guide-arms, K, and its end is inserted in the conical hole, B. It is then turned round between the finger and thumb, and the knife-edge coming into contact with the end to be sharpened, quickly pares off the material. By this simple apparatus an excellent point is given to the pencil in a very short time, saving the draughtsman from all the troubles and inconveniences of blunt pen-knives and fractured lead.

CRANK-HANDLED SCREW-TANG FILE.

Rigistered for Messrs. Fisher & Bramall, *Hoyle Street Works, Sheffield.*

The "crank-handled screw-tang file" has been designed to afford the workman greater command over his tool in flat-filing. Fig 1, of our

Fig. 1.



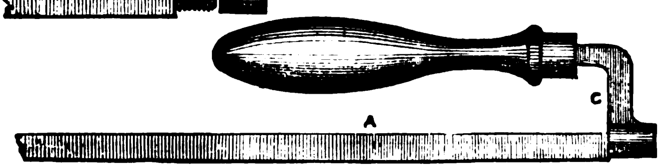


Fig. 2.

engravings, is a side view of a portion of the file, and handle detached, but just on the point of being screwed together, or connected. Fig. 2 is a similar view, showing how, for certain purposes, the handle may be put on to overhang the file. The file, A, has its tang, B, screw-threaded throughout its length, for attachment to the tapped eye at the end of the cranked tang, C, of the handle. This cranked tang is a fixture in the handle, so that the latter may in a moment be connected or disconnected from the file, merely by entering the screw. It forms a very effective and convenient tool.

TABLE-KNIFE.

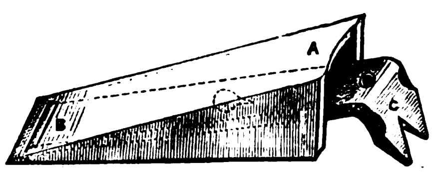
Registered for Messrs. Newbould & Baildon, *Surrey Works, Sheffield.*

Messrs. Newbould & Baildon's new table-knife embodies an improvement in the handle, for the prevention of that frequently recurring evil —the loosening by hot water. The tang of the blade is made flat, and fits tightly into the handle, so as to dispense with the help of cement of any kind, and its extremity is passed through the centre of the usual lead balance-weight placed in the hollow of the handle, very near the butt or extreme end. There the tang, projecting through the end, is securely riveted on to a metal washer outside. It is thus impossible for the handle to become loose, but it is evident that this security is only effected at the expense of an external mark at the end, which ought, if possible, to be avoided.

ALARM DOOR AND WINDOW WEDGE.

Registered for Mr. W. A. Biddell, *St. John's Square, Clerkenwell, London.*

Mr. Biddell's "alarm wedge" is intended for adjustment to doors or windows in such a manner that, on any attempt to force an entrance, an alarm is at once given to the inmates by the explosion of a detonating ball. Our engraving is a perspective sketch of the wedge, which is nothing more than an open-bottomed wedge-shaped metal box, A, having a short lever jointed to it at B, near one end, the opposite end of the lever being bent to a sharp angle at C. This lever fits to the hollow of the box wedge, which is put in action by inserting the thin end of the wedge beneath the



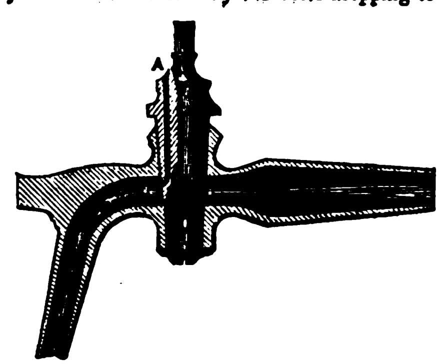
door or line of the window, pressing the pointed end of the lever into the floor. This done, the box is raised to allow of a small detonating ball being dropped in between the lever and box. When thus set, any attempt to force the door or window, compresses and explodes the detonator, giving a loud alarm.

SAVE-ALL TAP.

Registered for Mr. W. S. Adams, *Haymarket, London.*

Every one must have noticed the dirt and waste caused by the dropping of the fluid from the old form of tap for a short time after being used to run off a supply. This arises from the atmospheric pressure at the discharging mouth of the tap, whereby the fluid contained in the passage extending from the key of the tap to the orifice, is cut off from the current, and being held suspended for a few seconds, finally falls to the ground and is wasted.

Our engraving is a vertical longitudinal section of Mr. Adams's "save-all tap," which effectually avoids all the loss by the after dropping to which we have referred.



The slight modification by which he effects this result, is as simple as its result is effective. All that he does, is to form a small air passage, A, down the plug from the upper shoulder, opening by a side turn, through the metal of the plug at the part opposite the fluid's channel. When so made—the turning of the plug to the position represented in our illustrative figure —to shut off the flow, it opens an external atmospheric communication with the passage, B, and the air thus admitted thoroughly discharges

whatever fluid may be held in suspension in this passage, leaving it clear and dry.

Those who are in the habit of frequent drawing from a cask, will, no doubt, appreciate the saving which this tap promises. As to price, the maker states that they cost no more than the old kind.

DUPLEX ANGLE-IRON FOR THE CUP AND DIP OF GAS-HOLDERS.

Registered for Mr. W. Mabon, *Ardwick Iron Works, Manchester.*

Mr. Mabon's double angle-iron promises to effect great economy in the particular branch of construction for which he has registered it, as well as in many others to which it is not difficult to see that it may be judiciously applied. Fig. 1, of our engravings, represents a transverse vertical section of the "cup and dip" of a telescope gas-holder, showing the application of the double angle-iron at A and B; and fig. 2 is an enlarged section of the angle-iron detached.

Fig. 1.

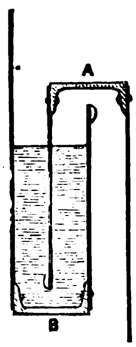
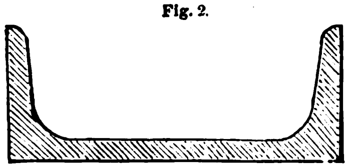


Fig. 2.



The ends of the bars are neatly filed to a true joint, and plated inside with a joint-plate of a similar section, and well riveted, the holes being countersunk and filed off flush, so that the ring presents one uniform plane, and has a neater appearance than the ordinary plan of jointing with two bars of angle-iron.

LOCK.

Registered for Mr. Henry Squire, *Willenhall, Stafford.*

This lock, for which its inventor claims a superiority over every other in point of safety, is represented in side elevation, in fig. 1 of our engravings, fig. 2 being a side elevation of its key. A, Is the principal bolt, which is acted on by the key in the usual manner, and B is a second bolt of a similar action and construction; the office of the latter being to act as a guard or protector for the principal bolt, by means of the pinion, C, which gears with the toothed racks formed for that purpose on the ends of the two bolts, A and B. The key has two bits, D and E, for the purpose of giving a simultaneous action to the two bolts. The bit, D, is first introduced through the cap, and falls on the chamber at F, when it is made to perform a semi-revolution, after which it may be introduced through the chamber at G, beneath which are the principal bolt and tumblers. The bit, E, is then in the position for working the protecting bolt, B, and its respective tumblers.

Fig. 1.

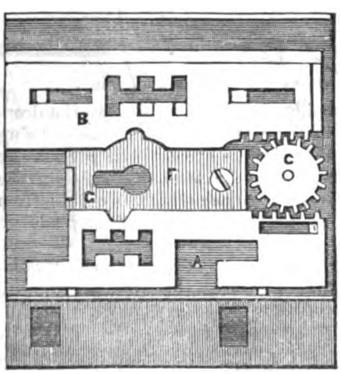


Fig. 2.

As this lock is on the principle of a double bit with one admitter, it possesses great advantages in keeping the principal bolt and tumblers in secrecy and security. The principal bolt cannot be shot or withdrawn, unless a key of the proper construction acts at the same time on both the bolts and their respective tumblers. The principle on which the two bolts and their respective tumblers are made, is said to render them equal to four bolts and eight tumblers, on the common principle. In addition to this, the patentee can attach detectors to the main protecting parts of the lock, so as to defy the most practised lock-picker.

REVIEWS OF NEW BOOKS.

The Steam-Engine: A Popular Account of its Construction, Action, and History, and a Description of its various Forms. By Hugo Reid. Third Edition. Pp. 269. London: Groombridge. 1851.

This little work, like Bourne's Catechism of the Steam-Engine, and Lardner's Rudimentary Treatise, aims at affording to those ignorant of the construction of the great mechanical wonder of the age, some general information on the subject. The fact of this being the third edition proves that the work has been hitherto well received. It is clearly written, and the text is illustrated by forty wood-engravings. We must remark, however, that the author, in our opinion, digs rather too much about the root of the matter, for the greater part of the first seventy-nine pages are occupied with a treatise on attraction, repulsion, the barometer, thermometer, and the constitution of water and air—subjects which most people have been already instructed in at school, and which might have been dismissed with as many lines as they occupy pages. Moreover, twenty-nine pages at the end of the book are filled with remarks on certain statements regarding the invention of the steam-engine, contained in Arago's historical *eloge* of James Watt. These observations, however interesting in themselves, are surely out of place when extended to their present length, in an elementary treatise of this kind. The remainder of the book, namely, 156 pages out of 269, contains a well-written sketch of the history and construction of the steam-engine. There are sections on high-pressure engines, direct-action engines, rotatory engines, and railroad engines, and one on steam navigation; all of which will be readily understood "by the meanest capacity." Upon the whole, we can recommend this revised and improved edition to those commencing their studies of the great machine.

Thoughts on Electricity, with Notes of Experiments. By Charles Chalmers, late of Merchiston Academy. Third Edition. Pp. 57. Edinburgh: Sutherland & Knox. 1851.

The first edition of this work appeared in 1849.* The author believes that his experiments prove that oxygen may be evolved from water without hydrogen, and hydrogen from water without oxygen. The experiments which he details lead to a series of questions, which show that the author entertains opinions widely at variance with received notions.

"Is water," he asks, "an elementary body? Does it combine with positive electricity, and is oxygen the product? Does it combine with negative electricity, and is hydrogen the product? Are oxygen and hydrogen, therefore, compound bodies; oxygen formed by the union of water with positive electricity—hydrogen formed by the union of water with negative electricity? And when these two gases are mixed together in their equivalent proportions, and raised to a given temperature, are they decomposed? Does the positive electricity of the oxygen combine with the negative electricity of the hydrogen, heat being the product? And is the water which was in combination with the respective electricities given off?"

Again,

"Is heat a binary compound? and are its elements the two electricities? When the two electricities combine, what is the product? Is it not heat? If heat is a binary compound, of which the elements are the two electricities, then is it by the decomposition of heat that electricity by friction, as well as electricity by induction, is evolved?"

Another part of the work contains an account of the application of Sime's mechanical principle to the common zinc and copper battery, as also to the constant battery of Professor Daniell. The author's views on this subject have been already given at page 249 of the second volume of the *Practical Mechanic's Journal.*

CORRESPONDENCE.

PUBLIC WORKSHOP FOR INVENTORS.

Allow me, through the medium of your valuable Journal, to direct the attention of inventors to the great advantage that would arise from their uniting to promote the accomplishment of their wishes, by establishing an easy mode of constructing their machines, by means of a *public workshop*, and also a general depository to preserve them in.

Inventors ought to unite and begin with the formation of a large workshop, fitted up with implements, such as those at our greatest engineers' establishments. By these means, works could be effectively, expeditiously, and very cheaply constructed, which private individuals could not accomplish without great labour and expense. In order to do this, each member should subscribe according to his means, in very small sums, and for which he should have free access to the workshop, with the privilege of working in it himself, and engaging the workmen there

* See review at page 279, Vol. II., *Practical Mechanic's Journal.*

to act for him, but paying them accordingly, notwithstanding his subscription has been paid; and the advantage would be, not that he could get his work done for nothing, but that he would have superior facilities for its performance.

Connected with the workshop should be the depository or museum, in which should be placed and preserved all worthy inventions, and clever men appointed there to preserve them in repair.

Should this plan be accomplished—through your influence—I am convinced that great benefits would not only arise to the inventive portion of the community, but to the world at large.

LEWIS GOMPERTZ.

London, Sept., 1851.

BUSBY'S CENTRIFUGAL PUMP.

In the history of the centrifugal pump and its progress, as given in this month's part of the *Practical Mechanic's Journal*, you have left out all mention of the apparatus for raising water by centrifugal force, patented by Busby and Eckstein about sixteen years since, I believe, under the title of "Certain improvements in machinery or apparatus for heating buildings, &c., by the circulation of water."

A description of this centrifugal apparatus is also given in Hood's work upon "Warming Buildings by Hot Water," &c. I hope in your next you will publish a description of this apparatus, for, as my father's patent has now expired, the publication of it might materially assist in developing the application of centrifugal force.

GEORGE ECKSTEIN.

North Moor, Oldham, Sept., 1851.

[The patent to which our correspondent has here directed our attention, is one taken out in May, 1832, by Mr. C. A. Busby of Stove, Brighton, under the title of "An improved method of producing the circulation of fluids through pipes, cisterns, or other vessels, applicable to the warming or cooling the interior of buildings, and to other purposes." Obscurely hidden in this unlikely corner, is an arrangement of a centrifugal fan, driven by a smoke-jack fly in the chimney, and made to give motion to the fluid to produce a heated current, for the purpose specified,—the peculiar feature of the plan being the reversing the relative motions of the hot and cold water, the former descending from, whilst the latter ascends into, the boiler.

The specification is unaccompanied by drawings, but we are enabled to make out Mr. Busby's plans from some sketches subsequently published by him, as well as from a diagram given in "Hood on Warming Buildings." The chimney-vane is fast on a vertical spindle, projecting downwards into an open-topped pipe on an ordinary kitchen boiler placed behind the fire-grate, and this spindle has on its lower end a "circulator, constructed and fixed like the wheel of a winnowing machine." This circulator, elsewhere called a "fan, or beater," is nowhere more clearly described, and the sketches to which we have referred show it only as an ordinary radial-vaned fan. As the current up the chimney actuates the fly, or smoke vane, the consequent revolution of the fan below imparts centrifugal force to the water in the open pipe of the boiler, causing the fluid to be depressed in the axial line of the fan, and rise correspondingly at the periphery of the vanes, inside the pipe. The two ends of the circulating heating pipe open into the boiler, the hot-water departure end being in communication with the bottom of the short pipe in which the fan works; whilst the opposite, or cold-water return end, opens into the boiler exactly in the axial line of the fans, and beneath the vanes. The end of the latter pipe, then, is under a less pressure of water than the hot-water pipe, which is affected by the centrifugal elevation of the fluid. The result is, that the hot water is made to descend, and pass round the apartment, whilst, when cooled, it is drawn into the central hollow caused by the revolution of the fan in the top of the boiler. It would appear that this invention is only applicable for producing a quick fluid circulation, in situations where the circulating pipes are too short to secure it by the mere difference in the relative specific gravities of the hot and cold water. All the evidence of its practical application which we possess, is a statement of an experimental trial on the premises of Mr. Eckstein of Holborn Bars.

Although, in deference to Mr. Eckstein's request, we have gone thus far into this application of centrifugal force, we must distinctly remark that it has nothing whatever to do with the history of the centrifugal pump. Mr. Busby's apparatus is not a pump. All that he intended to accomplish—and he has accomplished it with much ingenuity—was the variation in the boiler water-level of a single inch, to produce a force antagonistic to that ordinarily occurring between hot and cold water columns. Had we even included in our "Historical Review" all the plans which have some remote reference to pumping, we should have accumulated a vast mass of ancient invention, having no real connection with the history of the centrifugal pump.—ED. P. M. JOURNAL.]

HAND-BRAKE FOR THE PREVENTION OF MINE ACCIDENTS.

It appears to me, that accidents, such as that which happened lately at the Malago Pits, near Bristol, might be avoided by the use of a simple piece of machinery attached to the cage, to act as a brake, similar to Fourdrinier's apparatus, but instead of self-acting, I would have it made for the men to work themselves, if they felt anything going wrong.

I need not take up your time with the details of such a brake; any mechanic could make a piece of machinery to stop the cage, by applying wedges to, or chipping the guide posts. I should propose two cages of this description for each pit, made of an extra strength, and provided with a top sufficient to bear the fall of the rope; and I should forbid men to ascend or descend, except in these cages, and in the company of an efficient brakesman. For minerals, I should use the curve as at present. I have seen Fourdrinier's patent improvements, and admire much the neat and efficient apparatus. Self-acting machinery often goes wrong when needed, and I should prefer something which could not, by any possibility, get out of order.

F. EDENSIS.

DISCONNECTING APPARATUS FOR PADDLE-WHEELS.

My sketches represent an arrangement of gearing and screws, for working the well-known friction disconnecting apparatus of paddle-wheels, as a substitute for the ordinary cutter, being accessible in all positions of the engines. Fig. 1 is a side elevation of the apparatus, having a part of the disc broken away to show the internal arrangement of the adjusting pressure-screws and worm-wheels; and fig. 2 is a vertical

Fig 1.

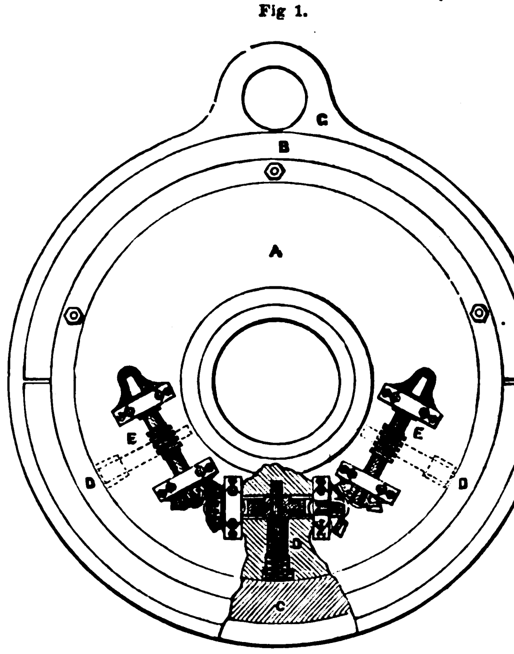
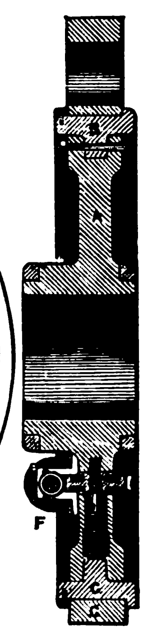


Fig. 2.



transverse section corresponding. The disc, A, is grooved out round its periphery to receive a cast-iron ring, made in two halves, B C—the section, B, being bolted on as a fixture, to secure the requisite length of engine stroke, whilst the other half, C, is loose, to admit of its being tightened up by the three screws, D. These screws are actuated by the two external worm-shafts, E, carried in bearings bolted to the side of the disc, and having squared ends to receive a box-spanner to turn them. These worm-shafts are geared by bevil or angular wheels with a third worm-shaft, carried in bearings at F. The worm on this shaft gears with the teeth of a wheel projecting through the side of the disc, and fast on the central screw-spindle, D, whilst the remaining two screws, D, are similarly actuated by the other two worms, E.

A key applied to the squares of either of the two worm-spindles, E, thus works all three adjusting screws, D, pressing out the half-ring, C, against the external friction-ring, G, carrying the crank-pin.

As all the motion is derived from worm gearing, it is evident that the screws can have no tendency to slacken. If necessary, the centre screw may be set a small portion of a revolution in advance of the others, to throw rather more oval on the strap.

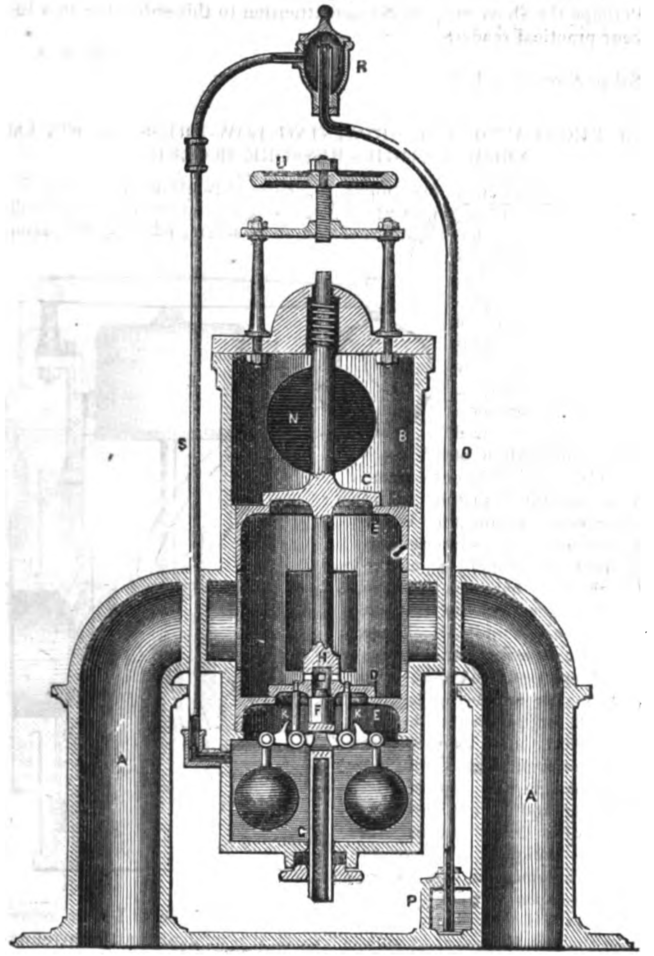
Cronstadt, Russia, August, 1851. JOHN ADAMSON.

NEIL'S IMPROVED SAFETY-VALVE.

Having been frequently led to the consideration of the condition of the existing safety apparatus for steam-boilers, I have been long convinced that the common valves are practically inefficient for preventing explosions. They do not allow a sufficiently free flow of steam when the pressure becomes dangerous, whether such pressure is progressively acquired, or the result of an unforeseen sudden generation. Besides this, the great load necessary to keep down the common valve at the working pressure has a decided tendency to neutralize its action when the escape does take place, and every one is acquainted with the fatal consequences of its tendency to gag.

With these defects before me, I have endeavoured to find a remedy in the plans which I shall now explain. Fig. 1, of the engravings, represents a vertical section of my proposed apparatus as fitted to the top of a boiler; and fig. 2 is an external plan corresponding. The bottom plate, together with the steam-pipes, A, and valve-chest, are cast in one piece, jointed and bolted down to the top of the boiler. The steam issuing from the boiler through the steam-pipes, A, into the valve-chest, B, produces an equal pressure upon the face of the upper valve, C, and the back of the lower valve, D, their areas being equal. Where the tubes are shown passed through, there is an internal thickness of metal around, giving passage for the steam on each side. The valve-lids, C and D, are cast in one piece with the spindle, and ground simultaneously to seats, E E, so as to be perfectly steam-tight. Of course, until the equilibrium is destroyed, the steam is confined to the chamber, B; but in order to give an immediate and copious discharge of steam from the boiler when the pressure exceeds that which is considered safe, the piston-valve, F, is brought into action. The square chamber, G, in which this valve is placed, is free from steam until the ordinary working pressure is exceeded by so many pounds per square inch.

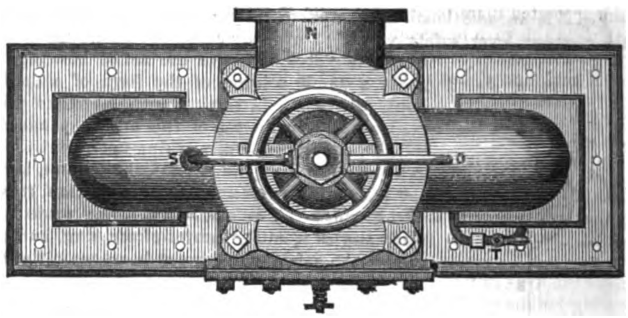
Fig. 1



1-16th.

The bottom end of this valve passes through a stuffing-box, which may be loosely packed with a little cotton or fine lint, and the upper end is reduced in diameter, so as to form a shoulder or collar, which is ground steam-tight, upon the face of the valve, D. The point is made to fit easily into the recess, H, truly bored out in the centre of the valve-face, and four small openings through the thickness of metal into the recess allow the steam in the valve-chamber, B, to act upon the point of the piston-valve. This valve is loaded by means of two double joints, K K, which are screwed firm to, and hang down from the valve-lid, D. In each of these a short lever is fitted, one end of the levers extending a little way into the oblong mortice through the body of the piston, bearing only upon the upper end of the mortice, thereby keeping the face of the piston-valve close to its seat upon the face of the valve, D. These levers are loaded—say to five pounds per square inch—above the ordinary working pressure required. When the pressure becomes greater than this valve is able to sustain, it will ease off from the face, and allow the steam to act upon an area equal to the full diameter of the piston, instantaneously opening and giving free egress for the steam from the chamber, B; the steam then rushing into the lower chamber, G, allows the full amount of steam-pressure in the chamber, B, to act upon the area of the valve-face, D, instantly raising the valve-spindle, M, with its appendages, the piston-valve, levers, and weights, and opening the escape-valve, C, permitting free passage of the steam from the boiler through the nozzle, N, into the atmosphere.

Fig. 2.



1-16th.

If from any cause the piston-valve does not act, and the steam pressure still increases, the mercury-tube, O, comes into operation. P, Is a box containing a quantity of mercury sufficient to form a column in height capable of resisting a pressure rather above that at which the piston-valve is calculated to open; and R, is a cup screwed upon the top of the tube into which the mercury is blown by the steam, when no longer able to resist the increased pressure; the steam rushing down the tube, S, has free access into the chamber, G, opening the valve, C, when the steam escapes into the atmosphere, as before described. The hand-wheel, U, with the screw attached, is for the purpose of regulating the lift of the valve; and, in cases where the apparatus has been brought into action after a sufficient quantity of steam has escaped, also serves to tighten the valves down to their face, until the steam contained in the chamber, G, is condensed; it is then taken up clear of the valve-spindle, so as to give the valve a lift equal to its area, or less, as may be thought proper.

A spiral spring is shown on the point of the spindle, which is intended to prevent any violent concussion of the valve when thrown open for the escape of the steam. The stop-cock, T, admits the steam into the box, P, and after the tube apparatus has been in action, is requisite for shutting off the steam from the box, that the mercury may be conveniently replaced; at all other times the cock requires to be kept open.

A small atmospheric valve is placed in the centre of the cover upon the front of the square chamber, G. This valve opens inwards, and has a light spiral spring outside, bearing upon the point of the spindle. It opens only by the pressure of the atmosphere, when a partial vacuum is formed in the chamber by the condensation of the steam remaining after the discharge-valve has been shut down, and by this means the internal and external pressure of the atmosphere will be kept in equilibrium to insure the proper action of the mercury in the tube, O.

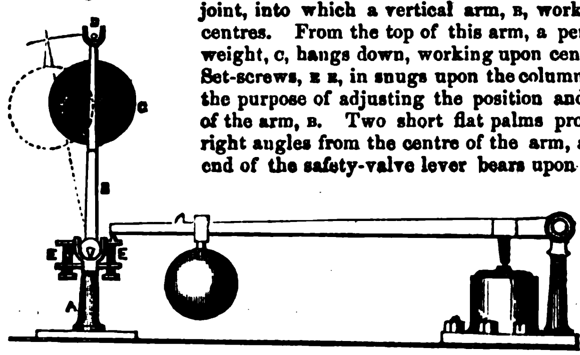
In cases where the mercury-tube alone may be attached to the apparatus, dispensing with the agency of the piston altogether, this air-valve will be necessary, as there will be no stuffing-box to serve as a medium through which air may have access into the chamber, G.

The diameter of the orifice of the discharge-valve, C, in my drawing, is 9 inches, the area being 63 square inches; the weight of valves and appendages say 130 lb., which will be equal to a load upon the valve of

only 2 lb. per square inch to keep it shut, against which, when the steam finds ingress to the chamber, G, there is a pressure, to open the valve, of 35 lbs. per square inch; this being the amount of pressure which the height of the column of mercury, as indicated by the drawing, is able to sustain. This valve is not intended entirely to supersede the ordinary apparatus, but for use as an additional precaution.

Fig. 3 is an additional apparatus to be worked in connection with the common lever safety-valve, to give a clearer egress of the steam from the valve, when in the act of blowing off. A, Is a small column of the form of a double joint, into which a vertical arm, B, works upon centres. From the top of this arm, a pendulum weight, C, hangs down, working upon centres, D. Set-screws, E E, in snugs upon the column, serve the purpose of adjusting the position and travel of the arm, B. Two short flat palms project at right angles from the centre of the arm, and the end of the safety-valve lever bears upon the top part of one of the palms. When the valve is shut, the under side of this palm rests upon the point of the set-screw, so as to allow the arm, B, to incline a little from the perpendicular, when at rest. When the valve is blowing off steam, the end of the lever being raised, allows the arm, B, to recede still further from the perpendicular, and by means of the weight, C, assists in raising the valve—permitting the steam to escape more freely. The opposite set-screw is for the purpose of regulating the amount of liberating weight required. When the valve is blowing off the steam pretty strongly, the end of the lever will be raised about 5-16th inch, and of course the travel of the arm will be in proportion. This additional apparatus might be of advantage in the working of the common safety-valve, as the steam, when blowing strong, is greatly above the pressure indicated by the load upon the lever, or in other words, the escape of the steam from the valve has no relation to the actual pressure in the boiler.

Fig. 3.

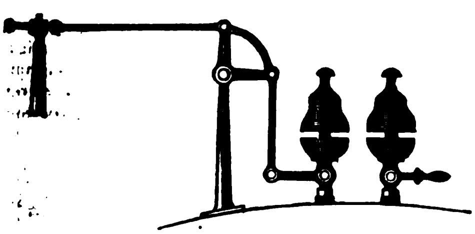


Glasgow, Sept., 1851. JAMES NEIL.

SIGNAL WHISTLE FOR RAILWAY TRAINS.

It is to be regretted that, notwithstanding the occurrence of numerous casualties showing the necessity of forming a communication between the guard and engineman of a train, no decisive attempt has ever been made to effect this much-called-for desideratum. I consider that the following simple and cheap arrangement, with such improvements as experience may suggest, would soon come into universal adoption.

An additional whistle is to be placed beside the ordinary one of the engineman, the handle to form a short lever thus:—A small pillar, placed at a convenient distance from the whistle, and carrying a common bell-crank, placed vertically, and connected with the end of the handle or lever of the whistle; from this a wire to run across to another bell-crank, placed horizontally on the top of another light rod or pillar, which would be in the line and elevation of the wire which is to run all the length of the train to the "passengers' luggage van," where the guard generally travels. Here he would be furnished with a handle, which, on his being made aware of any accident or necessity for stopping the train, he could immediately use, and attract the engineman's notice. The buffers of carriages are not all of the same length, but this could be compensated for by having a few loose links with a small spring catch; each carriage could thus be quickly connected, as at some stations, where carriages have to be put to or taken from the train, a simple and speedy means of connection is necessary. The wires could be carried along outside the carriage, and immediately under the eaves of the roof, which generally projects a little over the side of the carriage, and would thus be quite out of the reach of any mischievous passenger, as it would not do to give any one the power of stopping the train.



Next, we must have a communication between the guard and the passengers. For this purpose, a line of wires running along the opposite side of the carriage, similarly connected, would be attached to a bell in the luggage van; and by having a handle in every compartment of each carriage in the train, the guard would then require to get information from the particular carriage in which the bell-wire was pulled, what was the matter. Messrs. Bryden of Edinburgh have, I understand, made some very ingenious arrangements for bell communications, and I should consider this a very simple application.

The American system of building carriages, having a door of communication between each carriage, presents an effectual means of informing the guard, wherever he may be, of any accident; while, under our system, passengers are cooped up in a regular prison.

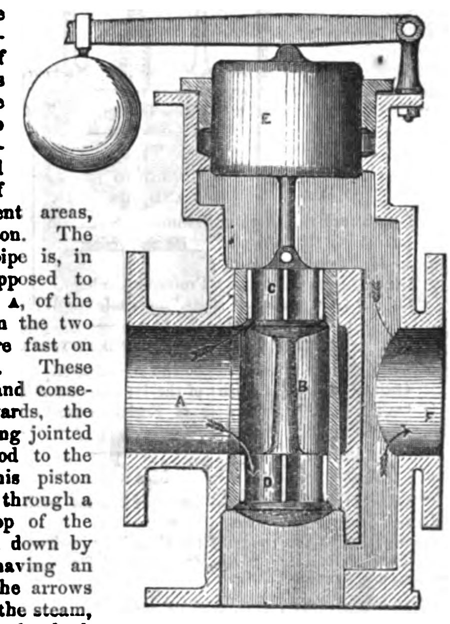
Perhaps the above may elicit some attention to this subject from some of your practical readers.

W. P. S.

Salop, September, 1851.

SELF-REGULATOR FOR OBTAINING LOW-PRESSURE STEAM FROM A HIGH-PRESSURE BOILER.

In the description of my duplex pressure regulating apparatus, delineated in Plate 75 of the *Practical Mechanic's Journal*, reference is made to one or two other modifications of the mechanism, whereby the same effect is producible by simplified means. The annexed sketch represents another plan of great simplicity. It is a vertical section of the duplex valve-chest, so arranged that the necessary action is secured by the combination of two valves of different areas, and a weighted piston. The high-pressure steam-pipe is, in this arrangement, supposed to open into the branch, A, of the valve-chest, B, between the two valves, C D, which are fast on one vertical spindle. These valves are inverted, and consequently open downwards, the upper smaller one being jointed by a link or piston-rod to the solid piston, E. This piston works like a plunger through a stuffing-box in the top of the valve case, and is held down by an overhead lever having an adjustable weight. The arrows indicate the course of the steam, which escapes through both valves to the low-pressure discharge pipe, F. Although I have represented the two valves, as of different areas, it is evident that the arrangement may be worked with valves equal in size. But in that case a greater weight would be required on the lever over the low pressure piston, E.



D. AULD.

Glasgow, September, 1851.

THE VENTILATION OF STEAM-VESSELS.

The ventilation of steamers being of great importance, especially in those passing warm latitudes, and in the war steamers on the coast of Africa, I propose to make known, through the medium of the *Practical Mechanic's Journal*, a plan of my own for the improvement of the present system. The plan has reference to paddle vessels, and consists in taking advantage of the objectionable back-water. A small water-wheel is placed abaft the paddle, and caused to revolve by the action of the elevated water. This water is collected into a species of funnel, formed by casing the inside of the back part of the paddle-box, half-way up, with iron, set about three or four inches from the outer case. The water elevated by the paddle-boards, falling into this inner box, is conveyed thence to the wheel by a wooden channel, and the revolution of the

wheel so caused, may then be applied for driving a fan for the use of the engine fires, or wherever else it may be wanted.

The best position for the water-wheel, would be at such a distance from the paddle, that the wave formed by the latter might not interfere with it, and the collector, or case for the water, should be furnished with a species of damper, to regulate the access of the fluid. If objection should be made to this arrangement, on the ground of the liability to injury during stormy weather, I would propose to make the wheel removable. The shipping and unshipping would not be difficult, as the wheel would only be three or four feet diameter, and when the damper is closed, the paddle-box would be just as before.

Queenstown, Sept., 1851. TAU ALPHA.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

TWENTY-FIRST MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

MONDAY

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE.

Colonel Sabine read a "Report on the Kew Magnetographs."

"On our Ignorance of the General Course of the Tides," by Dr. Whewell.

The Earl of Rosse then explained attempts which he had lately made, and with considerable success, to produce plane speculums of silver for reflecting telescopes.

"Inquiries into some Physical Properties of the Solid and Liquid Parts of Plants," by Professor Wartmann.

"On the Meteorology of Southampton, with reduced Observations for Three Years," by Dr. Drew.—This communication was considered by the Committee of the Section to be of sufficient importance to warrant them in recommending the reduced tables of observations to be printed at length in the next volume of the Reports of the Proceedings.

"Observations on the Aurora Borealis," by Mr. E. J. Lowe, consisted of numerous observations of that meteor, carefully recorded.

"The Annual Report on the Kew Observatory," by Mr. Ronalds, was now read.

FRIDAY.

SECTION B.—CHEMISTRY—INCLUDING ITS APPLICATION TO AGRICULTURE AND THE ARTS.

"Observations on Atomic Volumes and Atomic Weights, with considerations on the probability that certain bodies now considered as elementary may be decomposed," by Professor Dumas.

"On Liquid Diffusion," by Professor Graham.

"On the Constitution of Salts," by Professor Williamson.

SECTION C.—GEOLOGY AND PHYSICAL GEOGRAPHY.

"On Klinology in reference to the Bavarian Alps," by Dr. Schafhaeutl.

"On the Geology of a part of the Himalaya and Thibet," by Capt. Strachey.

"On the Drift and Surfaces of Rocks on the Coast of Scotland," by Sir R. I. Murchison.

MONDAY.

"On new Fossil Mammalia from the Eocene freshwater formation at Hardwell, Hants," by Professor Owen.

"On the Echinodermata of the Crag," by Professor E. Forbes.

"On the Discovery, by Dr. Overweg, of Devonian Rocks in North Africa," by Professor E. Forbes.

"On the Remains of a Gigantic Bird from the London Clay of Sheppy;" and "On the Pterodactyles of the Chalk Formation," by Mr. Bowerbank.

"On the Age of the Copper-bearing Rocks of Lakes Superior and Huron, and various facts relating to the physical structure of Canada," by Mr. W. E. Logan.

"On the Silurian Fossils of Canada," by Mr. J. W. Salter.—Lower Silurian, Allumette Island.

Mr. Logan exhibited a slab of Potsdam sandstone, with tracks like those of a tortoise, which is regarded by Professor Owen as proving the existence of an air-breathing four-footed animal at the very earliest period of known animal life.

THURSDAY.

SECTION D.—NATURAL HISTORY, INCLUDING PHYSIOLOGY

"On the Theory of the Formation of Wood and the Descent of the Sap in Plants," by Dr. Lankester.

"Report on the Structure, Habits, and Classification of the British Annelidæ," by Dr. T. Williams.—This report was illustrated by upwards of 200 drawings.

FRIDAY.

"On the Structure of the Branchiæ and Mechanism of Breathing in the Pholades and other Lamellibranchiate Mollusca," by Dr. T. Williams.

"On some Indications of the Molluscous Fauna of the Azores and St. Helena," by Professor E. Forbes.

The author infers that the coast-line of the ancient land of which the Atlantic islands north of the line are fragments, had a bend indicated by the distribution of the *Littorina striata*, a species remarkable for being common to the Azores, Madeira, the Cape de Verds, and the Guinea coast; and that the ancient connexion of the Azores with the Lusitanian land on the one hand, and Maderian on the other, as previously maintained by him, is supported strongly by these additional data. On the other hand, the facts concerning St. Helena indicate, as the indigenous vegetation of that island had previously done, that it had been insulated from a very ancient period, and had never been connected with the continent. At the same time, the marine molluscus would seem to point to the submergence of a tract of land, probably linking Africa with South America, before the elevation of St. Helena. Along the sea-coast of such a tract of land, the creatures common to the West Indian and Senegal seas might have been diffused.

"Account of Researches upon the Structure of the Acalephæ," by Mr. T. H. Huxley.

SECTION E.—GEOGRAPHY AND ETHNOLOGY.

"On Ethnographical Classification, considered with peculiar reference to the two unsolved Problems in Indo-Germanic Philology," by the Rev. J. W. Donaldson.—The two unsolved problems in Indo-Germanic philology are—first, the amount and nature of the affinity which connects the Indo-Germanic and Semitic branches of the human family: secondly, the origin and interpretation of the ancient Etruscan language.

"A Summary of Recent Nilotic Discovery," by Dr. Beke.

Mr. J. Crawford read a voluminous paper "On the Geography of Borneo," superadding a description of the condition of the island and of its chief products—illustrated by historical references.

M. D'Abbadie read a "Synopsis of seventy-two languages of Abyssinia and the adjacent Countries."

SECTION F. STATISTICS.

"Statistics of the Attendance in School for Children of the Poorer Classes," by Mr. J. Fletcher.

"On the Mathematical Exposition of some Doctrines of Political Economy," by the Rev. Dr. Whewell.

TUESDAY.

"On a General Theory of Gases," by Mr. J. J. Waterston, Bombay.

"General View of the Results of the Hypothesis of Molecular Vortices, as applied to the Theory of Elasticity and Heat," by Mr. W. J. M. Rankine.

"On the Effect of the Telescopic Funnels of Steam Ships on their Compasses," by Captain Johnson, R.N.

"On the Influence of the Earth's Magnetism on the Pendulum of Foucault," by Professor Walker.

"On a New Method of Determining the Quantity of Hygrometric Moisture in the Air," by Dr. Andrews.—Dr. Andrews had found on trial that several powders, when well dried, would rapidly, effectually, and completely take up the moisture of damp air passed through them, as effectually as the fused chloride of calcium, which is too troublesome in the making, preserving, and using, for common use. For instance, he had found that well dried black oxide of manganese—and a still more universally obtainable substance, powdered alabaster, or sulphate of lime, as dried and prepared by plasterers, or by those who make casts—being inclosed in a small syphon, a measured bulk of air passed through either at a very quick, or at the slowest rate, would be so effectually deprived of all its hygrometric moisture, that another syphon filled with coarser fragments of fused chloride of calcium gained no weight sensible to a balance which turned with the one-thousandth part of a grain, the measured portion of damp air being in succession drawn through the syphon containing the alabaster and that containing the fused chloride of calcium. The apparatus contrived by Dr. Andrews, a drawing of which Professor Stevely exhibited and explained, consisted of a gasometer whose bell was attached as a counterpoise to the weight of a Dutch clock sufficiently heavy to work it. By this a measured volume of air was drawn through a tube leading from the open air through the syphon containing the absorbent powder, which was attached to it by collars of caoutchouc, so that, after the air had passed through, the syphon could be readily detached, weighed, and the gain of weight by the absorption of the moisture thus determined. In this way he was able, in widely various hygrometric states of the air, to test the indications of Daniel's and other hygrometers—to determine the correct relation between the depression of the wet bulb and the dew point, and even to use the apparatus itself as a simple integrating hygrometer, by which the total quantity of vapour contained in a measured volume of air drawn through the apparatus, say during twelve hours, at a uniform rate, may be actually determined by weight.

"An Account of the Astronomical Instruments in the Great Exhibition," by Dr. Bateman.

"On Air-Bubbles formed in Water," by Dr. Tyndall.

"On an Experiment in Thermo-Electricity," by Professor Magnus, communicated by Dr. Tyndall.

"On some Appearances peculiar to Sunbeams," by Mr. Twining.

"Memoranda of Hail Storms in India from June, 1850, to May, 1851," communicated by Dr. Buist.

"Abstract of Meteorological Observations made at Futteguoh for 1850," by Dr. Buist.

"Sketch of the Climate of Western India," by Dr. Buist.

"On Storms," by Mr. R. Russell.

The Section then adjourned to the next new year's meeting at Belfast.

MONDAY.

SECTION B.—CHEMISTRY—INCLUDING ITS APPLICATION TO AGRICULTURE AND THE ARTS.

DR. DAUBENY IN THE CHAIR.

"On the Cause which maintains Bodies in the Spheroidal State, beyond the Sphere of Physicochemical Activity," by M. Boutigny.—Alluding to the disputed points in the explanation of his experiments as to the repulsion of metals and fluids, and whether the effects were really entirely or not to be attributed to the properties of the thin stratum of vapour, Professor Boutigny proceeded to show, by experiment, that when platina-wire was coiled up in the form of a flat spiral, and made hot, and ether or alcohol fluid placed on it, in the spheroidal state the liquid would not pass through between the spaces, while the vapour readily did so.

A conversation ensued on the subject of M. Boutigny's showing the capability of the human hand to pass through red-hot molten metal without injury; and by the prompt kindness of Messrs. Ransomes and May, the experiment was arranged to take place at 7 o'clock in the evening. Accordingly, at that hour, the members of the Chemical Section had the opportunity of seeing M. Boutigny pass his hand through the stream of liquid red-hot iron as it passed from the furnace, and afterwards scooping out portions of iron from the casting ladle, until the fluid sunk to the mere red-hot fluid state, when danger might be apprehended from the falling of the temperature causing the iron to adhere.

"On the Chemical Nomenclature of Organic Compounds," by Dr. DAUBENY.

"On some Theoretical and Practical Methods of determining the Caloric Efficiency of Coals," by Professor W. R. Johnson, of Washington, U.S.

"On the Products of the Action of Heat on Animal Substances," by Dr. T. Anderson.

"On the action of Superheated Steam upon Organic Bodies," by Prof. Scharling, of Copenhagen.—It appears that in Prussia, steam at 60 lb. pressure is used and passed through hot pipes to obtain at least 600° of heat, and is then thrown into compressed peat, where it produces the effect of a "fiery sponge," robbing the peat of water, carbonizing the material, and effecting the complete distillation of many substances. The texture of the peat is so far changed and peculiar that it is rendered pyrophoric and takes fire by exposure to air, and it is necessary to cool down the charcoal in an atmosphere of steam.

"On Agricultural Chemistry, especially in relation to the Mineral Theory of Baron Leibig," by Mr. J. B. Lawes and Dr. J. H. Gilbert.—[The reading of this paper commenced on Monday, and was resumed on Tuesday, with a discussion.]—Mr. Pusey had, in a recent article in the *Agricultural Journal*, on the progress of agriculture during the last eight years, quoted the experiments of Mr. Lawes and Dr. Gilbert as being conclusive against the "Mineral Theory" of Baron Liebig, which asserts that the crops on the farm rise and fall according to the supply within the soil of the mineral constituents indicated by an analysis of the ashes of the plant. To these observations of Mr. Pusey, Baron Liebig has replied at some length in the new edition of his "Letters on Chemistry," just published, and in doing so, has asserted that the experiments alluded to are without value, and that the statements of the authors could only be made in ignorance of the rationale of agricultural practices on the large scale. The authors have therefore given, in the present paper, an outline of their investigations in agricultural chemistry; comprising an extensive series of experiments in the field on the growth of the principal crops entering into a rotation, as well as on the chemistry of the feeding of animals, and that of the functional actions of plants generally, in relation to the soil and atmosphere: in connection with all of which branches much laboratory labour has constantly been in progress since the commencement of the experiments themselves in 1843. The results selected by Mr. Lawes and Dr. Gilbert, in justification and illustration of their views, were those of the field experiments on wheat, grown continuously on a previously exhausted soil for the last eight years, and in each season, by means of many chemical manures by the side always of one or more plots unmanured, and one manured continuously by farmyard manure. Some of the results thus obtained were illustrated by a diagram, from which it appeared that mineral manure had scarcely increased the produce at all when used alone, whilst the effects of ammoniacal salts were very marked, even when repeated year after year on the same space of ground from which the entire crop—corn and straw—had been removed. Indeed, in this way a produce had been attained even in the sixth and seventh succeeding years of the experiment, exceeding by nearly two-thirds that from the unmanured plot. It was then shown, that the mineral constituents of the soil continued to be in excess, relatively to the nitrogen available for them from natural sources. The history of several plots was then traced down to the last harvest (1850), and it was argued that the statements assailed by Liebig, viz., that ammonia was specially adapted as a manure for wheat, was fully borne out when speaking of agriculture as generally practised in Great Britain. In other words, that in practice it was the defect of nitrogen rather than of the mineral constituents that fixed the limit to our produce of corn. The authors next called attention to the fact of the exhalation of nitrogen by growing plants, as proved by the experiments of De Saussure, Daubeny, and Draper, and they referred to some experiments of their own, with the view of showing the probability that there is more of the nitrogen derived from manure given off during the growth of cereal grains than by leguminous and other crops; and hence might be explained the great demand upon nitrogenous manures observed in the growth of grain. The authors suggested that here was an important field of study, and that we have in the facts alluded to much that should lead us to suppose that the success of a rotation of crops depends on the degree in which the restoration of the balance of the organic constituents of crops was attained by its means, rather than on that of their mineral constituents, according to the theory of Liebig; whilst the means adopted to secure the farmer were always attended with a sufficient supply of the latter. Again, Professor Liebig has quoted the processes of fallowing and liming, as being in their known results inconsistent with the views of Mr. Lawes and Dr. Gilbert; but these gentlemen considered that the experiments of Mulder and of Mr. Way on the properties of soils, justified them in supposing that the processes of fallowing and liming owed their efficacy more to the accumulation of nitrogen in the soil from natural sources than to that of available mineral constituents: the latter did, however, undoubtedly thus accumulate by those processes, and this fact should give us more confidence in views which, on independent evidence, supposed that they were not so easily liable to be found in defect in relation to other necessary supplies. It was next shown, by reference to what happens in actual practice as generally followed in Great Britain, where corn and meat constitute almost the exclusive exports of the farm, that the mineral constituents of the crops taken collectively, that is, as shown by the analysis of their ashes, could not be considered as exhausted; of these, however, phosphoric acid was lost to the farm in much larger proportion than the alkalies; whilst the latter would generally, by the combined agencies of disintegration of the native soil, and import in cattle food, be liable to diminution in but a very insignificant degree, if not in some cases to accumulation. Practical agriculture had, indeed, decided that phosphoric acid must be returned to the land from sources external to the farm itself, viz., by bones, guano, or other means. But, on the other hand, artificial alkaline manures had generally been found to fail in effect. Indeed, taking into careful consideration the tendency of all experience in practical agriculture, as well as the collective results of a most laborious experimental investigation of the subject, both in the field and in the laboratory, it was the authors' deliberate opinion that the analysis of the crop is no direct guide whatever as to the nature of the manure required to be provided in the ordinary course of agriculture, from sources extraneous to the home-manures of the farm—that is to say, by artificial manures. Reviewing, then, the actual facts of practical agriculture, the authors could not agree with Baron Liebig when he asserted that our grand object should be, to attain an artificial mixture to substitute for farmyard manure, which he admitted to be the universal food of plants. The very practice of agriculture itself, as followed in this country, necessitates the production of farmyard manure, and all our calculations should be made on the supposition of its use.

"On Gambogic Acid, and the Gambogiates, and their use in Artistic Painting," by Dr. Scoffern.

"On the Dangers of the Mercurial Vapours in the Daguerreotype Process, and the means to obviate the same," by M. Claudet.

"On the use of a Polygon to ascertain the intensity of the Light at different angles in the Photographic Room," by M. Claudet.

"On the Construction and Principles of M. Pulvermacher's Patent Portable Chain Batteries for Electric purposes, with some of their effects," by Mr. Walenn.

"Report on Sulphuric Acid in the Air and Water of Towns," by Dr. R. A. Smith.—Specimens of the air taken in the summers of 1850 and 1851 from the densest parts of Manchester were compared with air from the country. The quantity of sulphuric acid, estimated in a tabular form, ranged from 0·4 to 1·06 grains to the gallon; the chlorine was from 0·396 to 0·530 to the gallon; while the total quantity of inorganic matter in rain-water was from 0·8 to 3 grains to the gallon. Dr. Smith alluded to the growth of conferva, and the production of some living bodies, and made observations on the office of rain-water thus clearing the air of matters affecting the health of man.

TUESDAY.

SECTION C.—GEOLOGY AND PHYSICAL GEOGRAPHY.

"Explication d'un Tableau de l'Etude Méthodique de la Terre et du Sol," by M. Constant Prévost.

Various fossil remains were then exhibited by the Rev. J. Gunn, and Mr. C. B. Rose.

Mr. Mallet presented his "Second Report on the Facts of Earthquakes," and stated the result of his experiments for the "Determination of the limits of Earthquake Wave Transit," for which the proposed plan was explained last year.—The rate of transit was expected to be the least rapid in sand, and most in some elastic, homogeneous, crystalline rock. Accordingly, a mile was measured on the sands near Dublin, and a cask of powder buried at one extremity—the interval between the firing of the powder and the indication of the shock at the other station, as registered by Wheatstone's chronograph, gave a rate of 965 feet per second, as the average of ten good experiments. A shorter base was measured on the granite, and shocks produced by borings 3½ inches diameter and 18 feet deep, in which as much as 20 lbs. of powder were exploded. The experiment was repeated twenty or thirty times, and where the granite was most shattered the shock arrived at the rate of only 1,209 feet per second; under the most favourable circumstances, where the rock was most homogeneous, the impulse travelled at 1,661 feet per second. In many of the most celebrated earthquakes clocks have been stopped, and thus indications afforded of the rate at which the shocks travelled. In the Lisbon earthquake of 1761, the shock travelled to Corunna at the rate of 1,994 feet, to Cork at the rate of 5,280 feet, and to Santa Cruz, in Barbary, at 3,261 feet per second. The great Cutch earthquake, in 1819, stopped the clocks in Calcutta, and showed a rate of 1,173 feet per second. The Nepaul earthquake of 1834 stopped numerous chronometers, and the rate of transit from the assumed centre to various places showed a rate varying from 1,000 to 3,000 feet per second. These rates were all lower than would be expected, considering rocks as homogeneous substances; and perhaps, after all, the earthquake shocks might follow a law altogether different from that of *sound* waves.

Mr. Mallet then called attention to the Catalogue of Earthquakes, amounting to nearly 6,000, and exhibited diagrams in which the amount of earthquake dis-

turbance in all known times was represented by curved lines; these showed a slight indication of paroxysmal periods, with intervals of half a century or more. Another diagram representing the months in which the shocks occurred, showed a maximum in December and January. Mr. Mallet then exhibited a map of the distribution of earthquakes, formed by colouring the area of each successive earthquake recorded in the catalogue, and one wash of colour being carried over another, produced tints of intensity proportioned to the frequency of these visitations. On this map the regions of Guinea, Abyssinia, and Madagascar were uncoloured, no *recorded* earthquakes having occurred in them; Greenland was uncoloured, because the slight shocks felt there might have been occasioned simply by movements of masses of ice upon the coast. Special attention was called to one spot in the Atlantic, near the line, and midway between Guinea and Brazil; vessels passing this tract almost always experienced shocks—the soundings were extremely variable, some being obtained at 400 fathoms, whilst at very small distances the depth was exceedingly great, as if the bottom was formed by a group of volcanic mountains. The connection between earthquake lines and volcanic lines was very apparent on this map; but some earthquake regions, like Central Siberia, and a tract extending from India to Bohemia, display very little volcanic energy. On a diagram section of the globe, the most distant points at which great earthquakes had been felt were connected by straight lines; these showed what very large portions of the mass of the earth might have been affected, supposing the original impulses to have been communicated at very great depths. Lastly, Mr. Mallet called attention to the great want of bibliographical catalogues in all public libraries, which rendered the search after earthquake literature a work of enormous labour.

Mr. Hopkins remarked, that whilst he placed no faith in such indications as those of earthquakes being more frequent in the winter, they were yet very curious; and it was not yet known how much might be due to the influence of apparently trivial causes. With regard to the condition of the interior of the globe, and looking at the earthquake map, he was still disposed to lean towards the hypothesis of the existence of internal lakes of fluid, more or less disconnected, in preference to a fluid central nucleus; earthquake shocks would be propagated to great distances beyond the boundaries of the agitated fluid.

"On indications of Upheavals and Depressions of the Land in India," by Dr. W. Buist.

Section D.—Natural History, including Physiology.

The following were the most interesting papers read:—

"On the Anatomy of the genus Sagitta," by Mr. T. H. Huxley.

"Remarks on the Vitality of Seeds," by Professor Henslow.—The author stated that during the last year he had planted several seeds sent to the committee appointed to report on this subject, and out of those he had planted two had grown. They both belonged to the order leguminosæ, and one was produced from seed seventeen, and the other from seed twenty years old. On the whole, it appeared that the seeds of leguminosæ retained their vitality longest. Tournefort had recorded an instance of beans growing after having been kept a hundred years, and Wildenow had observed a sensitive plant to grow from seed that had been kept sixty years. The instances of plants growing from seeds found in mummies were all erroneous. So also was the case, related by Dr. Lindley, of a raspberry bush growing from seed found in the inside of a man buried in an ancient barrow.

Mr. Babington related a case in which M. Fries, of Upsala, succeeded in growing a species of hieracium from seeds which had been in his herbarium upwards of fifty years. Desmoulins recorded an instance of the opening of some ancient tombs in which seed was found, and on being planted they produced species of scabiosa and heliotropium. Recently, some seeds from Egypt were sown in Cambridge which were thought to have germinated, but on examining them they were covered with a pitchy substance, which had evidently been applied subsequent to their germination, and thus they had preserved the appearance of growth through a long period of time.

Dr. Cleghorn stated, that after the burning or clearing of a forest in India, invariably there sprung up a new set of plants which were not known in the spot before.

"On the Botanical Geography of the Himalaya Mountains and Tibet," by Captain R. Strachey and Major Madden.—Captain Strachey described, by the aid of maps and diagrams, the principal features of the vegetable kingdom in the districts of India, in which he had travelled in company with Major Madden.

Dr. T. Thomson, also, by the aid of a series of diagrams representing the distribution of plants in Western Tibet, described the botanical geography of this district.

Dr. J. Hooker observed, that Captain Strachey and Dr. Thomson had done for the Himalaya what Humboldt had done for the Andes. The district of the Himalaya in which he had travelled was not unlike that just described; it was, however, higher, reaching to 28,000 feet, whilst that first described was only 25,000 feet. In the Sikkim Himalaya, the ascents were constantly modified by descents, and there was more rain, and the line of perpetual snow was lower than in Kumáon. Pines were alike abundant in both regions. The larch was abundant in Sikkim, but absent in Kumáon. Rhododendrons numbered thirty-six species in Sikkim, but only six or eight in Kumáon.—Mr. Winterbottom, who had travelled over the same districts with Captain Strachey and Dr. Thomson, compared the Flora of the Alps with that of the Himalaya, and pointed out the comparative richness of the latter. Where firs alone grew on the Alps, a most varied and beautiful vegetation was observed in the Himalaya. There was, however, a great difference in different districts. Where the rains fell, and the atmosphere was moist, there the vegetation was most prolific, but where there was a want of moisture, the land was sterile, and truly disagreeable to behold. Many of the plants were representative of European species.

"Report on the Reproduction of the higher Cryptogamiæ," by Mr. A. Henfrey.—This was an instalment of a Report, called for by the Association last year, on the recent progress of vegetable physiology, from Dr. Lindley, Dr. Lankester, and Mr. Henfrey. The greater part of this report was taken up by a summary of the facts at present on record respecting the occurrence of the organs termed antheridia and pistillidia in all the higher families of cryptogamic plants—viz., the mosses, liverworts, ferns, horse-tails, club-mosses, and pepperworts.

Section E.—Geography and Ethnology.

"On the Geography of Kumáon and Garhwál in the Himalaya Mountains," by Captain R. Strachey.—Captain Strachey began by giving a sketch of the general configuration of the surface of Central Asia; in which he pointed out that the elevated region known as Tibet formed the summit of a great protuberance above the general level of the earth's surface, of which the two mountain chains known by the name of the Himalaya and Kouenlun were nothing more than the south and north faces, these ranges having no definite special existence apart from the general mass. He then proceeded to give a more detailed account of the main physical features of the British provinces of Kumáon and Garhwál, in the Himalaya, and of the part of Tibet contiguous to our frontier to which his own observations had been restricted. The plains of Northern India extend along the entire southern edge of the Himalaya, over about 500,000 square miles, nowhere exceeding in elevation 1,200 feet above the sea. From these rise the mountains suddenly, and in a well-defined line. The exterior range, called the Siwaliks by Dr. Falconer and Colonel Cautley, is of no great elevation, hardly exceeding 3,000 feet. The characteristic tracts of swamp and dry forests that occur along its southern face, known as Tarai and Bhabar, and the longitudinal valleys, called Dún, along its northern slope were described. Immediately above these rise the first ranges of the great mountain region that extends to the north, over a breadth of upwards of 200 miles. The loftiest peaks, some of which exceed 28,000 feet in height, are usually found along a line of 80 or 90 miles from the southern edge of the chain, which in Kumáon neither is coincident with the water-shed, nor forms a continuous ridge, but is broken up into groups, separated by deep gorges, and connected by transverse spurs with the water-shed range that runs 20 or 30 miles further to the north. On crossing this water-shed, which forms the boundary between Tibet and our provinces, the traveller finds himself, not without astonishment, on a plain of 150 miles in length and 30 or 40 in breadth, the elevation of which varies from 16,000 feet along its southern edge to 14,500 feet in its more central parts, where it is cut through by the river Sutlej. It is everywhere intersected by stupendous ravines, that of the Sutlej being nearly 3,000 feet deep, which are furrowed out of the alluvial matter of which the plain is composed. The mountains that bound this plain to the north hardly enter the region of perpetual snow:—the famous peak of Kailas, which is nearly 22,000 feet in altitude, being the highest point. Captain Strachey then gave a brief account of his first journey into this country—in which, in company with Mr. J. E. Winterbottom, he reached the lakes of Rakastal and Manasarowar. which are found towards the eastern extremity of the plain, at an elevation of 15,200 feet.

A general view of the geology of these regions followed; from which it appeared, that from the Siwalik range, which was before known to be of tertiary age, the mountains are formed of metamorphic rocks, until we pass the line of greatest elevation. We then again find fossiliferous rocks, which form a regular sequence from the lower Silurian to the tertiary formations. Fossils from all of these beds have been collected and brought to this country by Captain Strachey. It is of the tertiary beds that is composed the great plain already described, and in them have been found fossilized remains of the elephant and rhinoceros at an elevation of between 14,000 and 15,000 feet above the sea. From a general consideration of these circumstances, it was inferred that the present wonderful development of the Himalaya and of the elevated regions of Tibet dates no further back than the tertiary period—being, in fact, one of the most recent changes that the surface of the earth has undergone. Proceeding from the solid crust of the earth to its aërial covering, an account was given of the chief meteorological phenomena; among which it will be sufficient to specify two of the most remarkable—namely, the glaciers and perpetual snow. Glaciers were shown to abound in all parts of the mountains covered with perpetual snow, descending as low as 11,500 feet. The snow-line, the height of which has given rise to much discussion, was stated to descend to about 15,500 feet on the southern face of the Himalaya; while it was pointed out that as we advance to the north of the great peaks, and stand on the mountains bordering the Tibetan plain, the snow line has receded to 19,000 or 20,000 feet. This phenomenon was shown to depend chiefly on the fact that the quantity of snow that falls to the north of the great Himalayan peaks is far less than that which falls on their southern slopes. Captain Strachey then passed to the description of the vegetation of these mountains. Its character was shown to be truly tropical up to elevations of about 4,000 feet, though even from 3,000 feet some of the forms of temperate climes begin to appear. The remarkable admixture of these temperate forms with those of the torrid zone that is met with in the valleys of the larger rivers that penetrate at a very low level far into the interior of the mountains, was also noticed. Above 4,000 feet, oaks, rhododendrons, and andromeda, form a very great proportion of the forest up to 7,000 feet; although in many places the *Pinus longifolia* clothes the slopes of the hills to the exclusion of everything else, nearly within the same limit, or from 3,000 to 6,000 feet. As we ascend, species of the deciduous trees of colder climates are introduced—and they, with the addition of other pines, prevail in the upper parts of the forest, from 8,000 to 11,500 feet, where arboreous vegetation is usually found to terminate rather suddenly.

Above this, a more open tract succeeds, in which the vegetation is for the most part herbaceous, few shrubs ascending so high as 14,000 feet. As we recede in our progress to the north, behind the higher summits of the range, the country rapidly becomes more arid; and when we reach the plain of Tibet, we find it to be almost a desert, on which few plants rise even to the height of a single foot. The vegetation—which though scanty, is still highly interesting from its similarity to that of the Arctic Regions—may be considered finally to cease at about 17,000 or 18,000 feet. After referring to the agriculture of this tract, in which the profitable cultivation of the cereal grains was shown to be carried up to about 14,000 feet, Captain Strachey concluded by an account of some of the zoological characteristics of the Tibetan plateau. He mentioned more particularly the kyang or wild ass, the yak, the wild and domestic sheep and goats, the ounce, and other animals, specimens of which he brought with him from that country, and which have lately been set up in the East India Company's Museum.

"On the Inhabitants of Kumáon and Garhwál," by Mr. J. Strachey.

"On the Negro Races of the Indian Archipelago and Pacific Islands," by Mr. J. Crawford.

Mr. Cull read a "Communication relative to the great Earthquake experienced in Chili, April 2, 1851, from R. Budge, Esq., to W Bollaert, Esq., in a letter dated April 17; with Observations by the latter."

Tuesday.

Sir R. I. Murchison opened the business of the Section, by bringing before it some notes of Sir James Brooke, the Rajah of Sarawak,—"On the Geography of the northern portion of Borneo." He pointed out the present state of our acquaintance with the geography of this great island, as derived from the researches of British travellers and surveyors, and as published in the recent map compiled by Mr. Petermann. He described the communication of the Rajah as important, in making known the ascent by Mr. Law of the lofty mountain of Kira Balav, (near 14,000 feet above the sea) situated in the north-eastern district, and the intention of Mr. St. John to proceed up the Barram river, between Sarawak and Labuan, and to visit the populous country of the Kayans, and perhaps that of the Kuineah; a people unknown to our geography, but numerous and hospitable, and speaking a language distinct from the Kayans or Dyaks. The Rajah adds—"Some letters from the Kyan chiefs of Barrum have lately been printed by order of the House of Commons, and will point out where the real danger to the progress of geographical research is to be apprehended."

Monday.

Section F.—Statistics.

Professor Hancock read a paper entitled, "Should Boards of Guardians endeavour to make Pauper Labour self-supporting, or should they investigate the Causes of Pauperism?"

The Secretary read a communication by Mr. Cocks, "On the Mortality in different Sections of the Metropolis in 1849."

Tuesday.

The Secretary read a paper, by Dr. E. T. Tilt, "On the best Means of Ascertaining the Number and Condition of the Infantile Idiots in the United Kingdom."

"On the Influence of Discoveries in Science and Works of Art in developing the Condition of a People, indicated by the Census Operations of the United States," by Mr. J. C. G. Kennedy.

"On the prospects of the Beet Sugar Manufacture in the United Kingdom," by Professor Hancock.—Public attention had been directed to this manufacture by the effort to establish a public company in London for its introduction into Ireland. He had learnt that at Maldon the manufacture had been attempted by a private company, but this attempt led to failure in a short time. A manufactory had been recently established at Chelmsford, and contracts had been entered into with the farmers in that neighbourhood. The prospects of the manufacture depended on the answers to three questions:—1st. What was the price of beet-root likely to be for a series of years? 2nd. What was the price of refined beet-sugar likely to be after 1854? and 3rd. Would it be profitable to carry on the manufacture at these probable prices of the raw produce and manufactured article?—As to the price of beet-root, its price varied in France from an average of 13s. 11d. per ton in the north-east of France, to 18s. 5d. per ton in the north-west of France. The average for the whole of France was 15s. 1½d. per ton. In Ireland, the price stated to be contracted for the Sugar Beet Company was 15s. 6d. per ton, and the price at Essex was from 18s. to 20s. per ton. Thus it appeared that the present price in Ireland was higher than the average of France, and the present price in England was higher than the average of the highest priced districts of France. What the future price in Ireland and England was likely to be was a difficult question, and had not been as yet fully investigated. As to the second question—the price of refined beet-sugar after 1854—it was necessary to take the year 1854, because at present there was a differential duty in favour of home grown beet-sugar, which would diminish each year, and cease after July, 1854. After that time the short price of refined beet-sugar would most probably not exceed 27s. to 28s. per cwt., and the long price would most probably not exceed 40s. 4d. to 41s. 4d. per cwt. Indeed, a fall below those prices might be anticipated from three causes:—1st. From the diminished cost of production of refined cane-sugar, consequent on the increased consumption produced by the fall in its market price from 49s. 4d. to 42s. 4d. per cwt. on the equalization of the duties. 2nd. From the removal of the absurd restrictions now imposed on cane-sugar refiners. 3d. From the competition between cane-sugar and beet-sugar, if the latter were manufactured to any extent.—As to the third question, would it be profitable to manufacture from beet-root at the Irish price of 15s. 6d. per ton, or the Essex price of 19s. per ton, refined sugar to sell at 28s. per cwt.? The calculations on this point which had been most relied on were two in number,—that of Mr. W. K. Sullivan, chemist to the Museum of Irish Industry in Dublin, and that of M. Paul Hamoir, of the firm of Serret, Hamoir, Duguesne, & Co., the largest manufacturers of beet-sugar at Valenciennes, dated 18th of April, 1850. These estimates were as follows:—

Mr. Sullivan's Estimate for Ireland.

60,000 tons of beet, at 15s. per ton,	£45,000
Cost of manufacture at 9s. per ton of beet,	27,000
Total outlay,	72,000
Produce, 5 per cent. of sugar, at 28s. per cwt.,	93,000
Estimated profit,	£21,000

Same Estimate applied to Essex.

60,000 tons of beet, at 19s. per ton,	£57,000
Cost of manufacture, at 9s. per ton of beet,	27,000
Total outlay,	84,000
Produce, 5 per cent. of sugar, at 28s. per cwt.,	93,000
Estimated profit, only	£9,000

M. Paul Hamoir's Estimate for France.

61,607 tons of beet, at 12s. 11d. per ton,	£38,400
Cost of manufacture, nearly 13s. per ton of beet,	39,900
Total outlay,	78,300
Produce, 4½ per cent. of sugar, at 39s. per cwt	114,000
Estimated profit in France,	£35,700

Same Estimate applied to Ireland.

61,607 tons of beet, at 15s. 6d. per ton,	£46,080
Cost of manufacture, nearly 13s. per ton of beet,	39,900
Total outlay,	85,980
Produce 4½ per cent. of sugar at 28s. per cwt.,	81,430
Estimated loss in Ireland,	£4,550

Same Estimate applied to Essex.

61,607 tons of beet, at 19s. per ton,	£58,527
Cost of manufacture, nearly 13s. per ton of beet,	39,900
Total outlay,	98,427
Produce 4½ per cent. of sugar, at 28s. per cwt.,	81,430
Estimated loss in Essex,	£16,997

From these simple calculations it appeared at once, that by only introducing into the estimates the Irish and English prices of beet-root and of refined beet-sugar, the result was so varied as to turn a profit of £35,000 at the French prices, on a capital of £78,000, into a loss of £4,000 at the Irish prices, and a loss of £16,000 at the Essex prices. It followed, therefore, that the French estimate did not, as had been alleged, corroborate Mr. Sullivan's estimate: on the contrary, it showed how fallacious it was to reason from the success of the manufacture in France to its success in the United Kingdom, without taking into account the difference of the prices of beet-root and refined beet-sugar in both countries,—the difference in economic conditions between the two countries being alone sufficient to make that which was profitable in France unprofitable here. The manufacture of beet-sugar had been first commenced in France when the continental system of Napoleon and the retaliation of England had almost excluded cane-sugar from France. From that time to the present, beet-sugar had always had the protection of an artificial price—(the present price being 39s. per cwt. in France as compared with 28s. per cwt. in this country). In every other country in the world where beet-sugar had been produced, it had the protection of an artificial high price. The conclusion was manifest, therefore, that from any calculations yet submitted to the public, it appeared that the manufacture of beet-sugar could not be profitably carried on in the United Kingdom.

INSTITUTION OF CIVIL ENGINEERS.

Since our last reports of this Society, the following papers have been read:—

"On the improvement of the Navigation of the river Newry," by Sir John Rennie.

"A description of a Raft or Float, used for Submarine Blasting, on the works of the Hartlepool West Harbour and Docks," by Mr. T. Casebourne.—This machine was contrived in consequence of the clay, or marl, forming the bed of the channel into the harbour, being so hard, at a certain depth, that the ordinary dredging machine was found to have little or no effect, owing to its want of stability. The new machine consisted of a platform, or raft, supported by four legs, on each of which was fastened a rack, working into a pinion on the deck, so that the platform could be raised or lowered at pleasure. The working level, on the ebb tide, was about eight feet above the level of the ground, in which position it remained for about five hours, or five hours and a half, until the tide flowed again. During this time two sets of boring-irons were in use, working through wooden boxes, or tubes, which made holes in the clay four inches in diameter, and of the required depth, for receiving a cartridge containing three to four pounds of powder, to which one of Bickford's fuzes was attached. The hole was then carefully tamped, and when the tide

rose to the level of the platform or raft, the fuzes were lighted, and the raft was floated away to some distance. The cost of this apparatus, complete, was stated to have been about £100.

"Description of the Lockwood Viaduct, on the Huddersfield and Sheffield Railway," by Mr. John Hawkshaw.

"Description of two Bridges over the River Don and the Canal, with the Lodge and Approaches, on the estate of Sir John Copley, Bart., at Spotbro', near Doncaster," by Mr. H. Carr.

"On the 'Nominal Horse-Power' of Steam-Engines," by Commander L. G. Heath, R.N.—The inadequacy of the present term—"nominal horse-power," for giving a definite idea either of the absolute or relative power of engines, was first examined by comparing the engines of H. M. S. *Garland* and *Basilisk*, which were both constructed on the same principle, with oscillating cylinders, and were both used to drive paddle-wheels. This comparison was made under three distinct heads—the mean effective pressure, the number of revolutions per minute, and the size of the cylinders. It was urged that Watt's constant of 7 lbs. per square inch, for the mean effective pressure, was not only in itself inapplicable, but that no constant quantity could be universally applicable. Also, that the method of determining the number of revolutions per minute, from a conventional speed, founded on the length of stroke of the piston, was equally fallacious.

It was, therefore, proposed that the term, "nominal horse-power," should be abolished, and that engines should in future be designated by the cubic contents of their steam cylinders, jointly with their nominal consumption of a standard description of fuel during a given period of one hour. A table might be drawn up giving this nominal consumption in terms of the grate and the heating surface, and should be accompanied by rules and directions for ensuring the uniform measurement of the grate and the heating surface. This system, it was contended, would be more in accordance with the present practice of construction, and would enable the relative size and power of engines to be more accurately estimated than by the present method.

In the ensuing discussion it was admitted, that it would be very desirable to fix the nomenclature of the power of engines; for though it was well known that James Watt did really take as his standard what he found to be actually performed by a powerful horse, drawing a weight over a pulley—viz., the equivalent of 33,000 lbs. raised one foot high in a minute—yet commercially it had gradually become a custom, among manufacturers, to give a surplus of power, ostensibly as an allowance for the friction and deficiencies of the machine, so that now, the mere statement of the nominal horse-power had no definite meaning.

It was, however, contended, that the standard of 33,000 lbs. should be retained; and that, supposing the workmanship to be equally good in two engines, it was only necessary to compare the areas of the cylinders, the effective pressure of steam on the piston, and the speed of the piston, to determine their relative power. This was, in fact, shown by the indicator, an instrument, the value of which was now universally admitted, and which, when skilfully used, did really give a true representation of the power of the engine.

It was the universal custom of Boulton and Watt, to calculate the power exerted by an engine, by the speed of the piston, together with the average pressure of the steam, as shown by the indicator; and although much vagueness and uncertainty had latterly been introduced into the subject, this was rather to be attributed to the assumption of arbitrary quantities to represent those results, than to any defect in Watt's standard horse-power, which definitely expressed both the measure of power, and the space through which it acted.

The proposed standard of comparison of the quantity of water evaporated in a given time, by a given amount of fuel, or the combustion of a given quantity of fuel in a given time, were shown to be of no value, as then not only the generation of the steam, but the administration of it, must be considered, and these were points merely tending to complicate the question.

For pumping engines in Cornwall, the term horse-power was almost unknown, engines being sold to raise a given quantity of water, which was a standard easily reducible to that of other districts, where 33,000 lbs. was assumed to be the actual power of a horse.

The commercial question of what a manufacturer should give as a horse-power, could not be discussed, for the actual power was only a small element in the actual cost of an engine, that varying with every peculiar application of the machine; the surplus power now given by manufacturers had evidently arisen from a more perfect machine being now produced, by the use of tools in the manufacture, the introduction of metallic rings instead of hemp packing, more perfect valves and numerous modifications, all of which were apart from, and independent of, the question of the original standard, which, it was admitted, could not be improved, and should not therefore be altered.

"On Foundations: natural and artificial," by Mr. S. Clegg, jun.

Mr. Joseph Whitworth exhibited, in the library, a new measuring machine, for determining minute differences of length. The accuracy of the machine was demonstrated by placing in it a standard yard measure, made of a bar of steel, about three quarters of an inch square, having both the ends rendered perfectly true. One end of the bar was then placed in contact with the face of the machine, and at the other end, between it and the other face of the machine, was interposed a small flat piece of steel, termed by the experimenter "the contact piece," whose sides were also rendered perfectly true and parallel. Each division on the micrometer represented the one-millionth part of an inch, and each time the micrometer was moved only one division forward, the experimenter raised the contact piece, allowing it to descend across the end of the bar by its own gravity only. This was repeated until the closer approximation of the surfaces prevented the contact piece from descending, when the measure was completed, and the number on the micrometer represented the dead length of the standard bar to the one millionth part of an inch.

Eight repetitions of the experiment in a quarter of an hour produced identical results, there not being in any case a variation of one millionth of an inch.

This method of operating was termed "the system of proof by the contact of perfectly true surfaces and gravity;" and in connexion with it was shown another interesting experiment.

When the micrometer was up within one division of the number where contact would be presumed to occur, the application of the finger to the centre of the steel bar sufficed to expand and lengthen it instantaneously, so as to prevent the descent of the "contact piece."

The other method of proof was by having a small simple battery, composed of a piece of zinc soldered on to a piece of copper and plunged into rain water, without the admixture of any acid; this was connected with the two ends of the measuring machine, and also with a delicate galvanometer. On pursuing the same process of advancing the micrometer, one division at a time, no effect was produced, until the last millionth of an inch of distance was traversed, and absolute contact occurred with the end of the bar, when the deflexion of the needle of the galvanometer instantly detected the movement. Repeated experiments showed this to be unerring in the result, and on placing the finger on the middle of the bar, under the same circumstances, as in the other course of experiments, the expansion was instantly detected by the deflexion of the galvanometer needle.

The delicacy of these experiments was so great as to preclude the possibility of making them in a crowd, or in a room with a varying temperature; therefore, although, the machine was destined for the National Exhibition, its merits could not be appreciated, or exhibited there; it was announced, however, that probably another opportunity would be afforded by Mr. Whitworth for the exhibition of this beautiful instrument, whose results were calculated to make great modifications in the calculations of the changes of volumes of metals and other substances under variation of temperature.

"On the Demonstration of the Rotation of the Earth, by means of two Pendulums," by Mr. Homersham Cox, B.A.—The demonstration of the rotation of the earth was usually made to depend on phenomena presented by the appearance of the heavens. Two mechanical experiments had, however, long been known, which demonstrated the fact that the earth revolved,—the one, the retardation of the pendulum by centrifugal force, a question discussed by Newton, Huygens, and others; the other, which was suggested by Newton, consisted in dropping, from a great height, a ball, which, by the diurnal motion, was moved somewhat to the eastward.

The experiment had hitherto been performed with *one* pendulum, but in the present instance *two* pendulums were used, and were suspended at a sufficient distance apart, to allow of the free vibration of each. The weights were held together by a thread, which on being burned released them, so that they were set vibrating, initially, in the same vertical plane; consequently to the eye of an observer situated in that plane, the two pendulum wires appeared co-incident, one of them covering, or eclipsing the other. In a short time, however, the course of the two pendulums visibly altered. As their planes of oscillation appeared to revolve the same way on the earth's surface, the wires no longer covered each other, but appeared to separate and alternately to cross each other.

The advantages of this mode of operating were, first, the rapidity with which the deviation of the pendulums was manifested; for as their planes revolved in the same apparent direction, their arcs diverged from each other twice as fast as either from its initial position; and secondly, the apparent crossing and re-crossing of the wires constituted, to the naked eye, a much more distinct and palpable test of the result, than the apparent motion referred to a plane beneath *one* pendulum.

"On a Mode of Computation for excluding Floodwater from a set of Gaugings of a Stream, taken at regular intervals," by Mr. James Leslie.

"Results of a Series of Practical Experiments on the Discharge of Water, by Overfalls, or Weirs," by Mr. T. S. Blackwell.

"On the Pneumatic Mode adopted in constructing the Foundations of the new Bridge, across the Medway, at Rochester," by Mr. John Hughes.—This bridge was described, as being designed to consist of three large openings, a central one of 170 feet in width, and two others, each of 140 feet in width, spanned by cast-iron segmental girders, and of a passage to admit masted vessels to the upper parts of the river, across which a moveable bridge would be placed. Each of the river piers occupied an area of 1,118 square feet, and rested upon a series of cast-iron cylinder piles, 7 feet in diameter, placed 9 feet apart longitudinally, and 10 feet transversely, so that there were fourteen under each pier. The cylinder piles in the abutments were 6 feet in diameter, of which the "Strood" abutment required thirty, and the "Rochester" abutment twelve. Each pile was composed of two, three, or more cylinders, 9 feet in length, bolted together through stout flanges; the bottom length had its lower edge bevelled, so as to facilitate the cutting through the ground. The bed of the river was originally presumed to consist of soft clay, sand, and gravel, overlaying the chalk, and accordingly the application of Dr. Potts' pneumatic method for forcing the cylinder piles into the ground, which had been successfully carried out in similar positions, was contemplated; but, after a few trials, the ground was found to consist of a compact mass of Kentish rag-stone, so that the mere atmospheric action upon the piles, induced by a partial vacuum, would be ineffective in such a situation. It was therefore decided, that the pneumatic process should be reversed, so as to give each pile the character of a diving-bell; for which purpose one of the cylinders, 7 feet in diameter, and 9 feet in length, had a wrought-iron cover securely bolted to it, through which two cast-iron chambers, "D" shaped in plan, with a sectional area of about 6 square feet, appropriately called "air-locks," projected 2 feet 6 inches above the top of the cylinder, and 3 feet 9 inches below the cover. The top of each "air-lock" was provided with a circular opening, 2 feet in diameter, with a flap working on a horizontal hinge, and an iron door, 2 feet by 3 feet 4 inches, with vertical

hinges below the cover; each "air-lock" was also furnished with two sets of cocks, the one for forming a communication between the cylinders and the chamber, the other between the chamber and the atmosphere. Compressed air was supplied to the cylinder pile by a double-barrelled pump, 12 inches in diameter, and 18 inches stroke, driven by a 6 horse-power non-condensing steam-engine. At first, the expelled water was made to pass into the river, from beneath the lower edge of the pile; but when the stratum became so compact as to oppose a high degree of resistance to the passage of the air, an outlet was formed through the side of the uppermost cylinder, by the introduction of a pipe, having the form of a syphon, the long leg of which reached to the bottom of the pile, and was subject to the pressure of the condensed air on the surface of the water within, whilst the short leg, leading into the river, had the effect of relieving the amount of compression, provided a vacuum was once obtained in the body of the syphon. Such an effect was readily produced by connecting the summit with the exhaust side of the air-pumps, by a pipe which could be opened or closed at pleasure. To insure the downward motion of the pile, and to give it a weight which should be at all times superior to the upward pressure, two stout-trussed timber beams were laid on the top of the cylinder, in a direction suitable for bringing the adjacent piles into action as counterbalance weights, by four chains passing over cast-iron sheaves.

Two light-wrought iron cranes were fixed inside the cylinder, the jibs of which swept over the space between the air-locks and windlasses, inside and outside, for the purpose of hoisting the loaded buckets and lowering the empty ones.

The method followed in working the apparatus was found to be so simple in detail as to be perfectly intelligible to all the workmen employed. The pumps being set in motion, the flap of one of the air-locks and the door of the other were closed; a few strokes compressed the air within the pile sufficiently to seal the joints, and whilst the pumping was in progress, the men passed through the air-locks to their respective stations. When the water was shallow, the pile descended, by scarcely sensible degrees, as fast as the excavation by hand permitted; but when the water was deep, the excavation was carried down full 14 inches below the edge of the pile, which then descended, at once, through the whole space, as soon as the pressure was eased off.

The most perfect certainty and success had attended the employment of this simple system, and as it promised to afford considerable assistance to engineers in the prosecution of similar works, the author laid the account before the Institution with the sanction of Mr. Cubitt, President Inst. C.E., the engineer-in-chief, and Messrs. Fox, Henderson, & Co., the contractors for the works.

"On the Isthmus of Suez and the Ancient Canals of Egypt," by Mr. Joseph Glyn.

The President closed the session by the usual conversazione, which, on this occasion, was graced by the presence of Prince Albert.

INSTITUTION OF MECHANICAL ENGINEERS.

June 30th, 1851.

At the last special general meeting, held at the rooms of the Society of Arts, in London, the business of the evening was opened by Mr. Joseph Beasley, who read a paper "On a new Machine for Blooming Iron," which was followed by an interesting discussion.

Mr. P. R. Hodge then read a paper "On the progress of Improvements in Locks in the United States of America," in which the latest of the transatlantic improvements in locks were severally discussed.

A paper by Mr. Henry Henson, "On Improvements in the Construction of Railway Waggons," was afterwards partially read, but was finally adjourned to the next meeting.

In the evening a party of 170 members and their friends dined together at the Freemasons' Tavern; Robert Stephenson, Esq., in the chair. This gathering was rendered more interesting from the great number of eminent foreigners who had been invited to the festivities in celebration of the epoch of the Great Exhibition.

July 30th, 1851.

At the general meeting, held in Birmingham on this day, Mr. Henson's paper "On Improvements in the Construction of Railway Waggons," was again entered upon and completed.

"On a new Regenerative Condenser for high and low pressure Steam-engines," by Mr. C. W. Siemens.

"On a new Blowing-engine, working at high Velocities," by Mr. A. Slate.

"On an improved mode of Moulding Railway Chairs," by Mr. E. A. Cowper.

ROYAL SCOTTISH SOCIETY OF ARTS.

The following papers have been recently read before this Society:—

"The progress of the Drainage of Haarlem Meer, during the months of January, February, and March, 1851," by Thomas Grainger, Esq.—The President stated that it might be interesting to the Society to be informed of the progress made in this great undertaking since he had the pleasure of bringing the subject under their notice in December last. At that period the lake had been lowered 7 feet 3 inches below the original level when enclosed. During the month of January, owing to an accident which happened to the "Cruquius" engine, and also from the "Lynden" being under repair, the surface of the lake rose rather more than 1½ inches. In February, although the "Lynden" engine had been repaired, yet, from the state of the weather, and also of the levels of the water in the surrounding canal, preventing the two engines from being fully worked, the lake was lowered only about 2 inches. By the middle of March, with two engines only at work, the lake was lowered 6.29 inches below what it was at the beginning of the month; but owing to the heavy rains which prevailed at the end of the month, this was reduced to 2.35 inches on the 31st. At that date the level had been reduced 7 feet 5.35 inches below the level at the time when the lake was enclosed. To give some idea of the actual amount of work involved in obtaining even the comparatively small diminution in depth which has taken place during these last three months—for this purpose the president assumed that the same quantity of rain had fallen in Holland as in this neighbourhood—an estimate which will not be far from the truth, as he finds, on an average of years, that the total rain-fall is very nearly the same. The quantity of rain during January, February, and March, from a rain guage kept by himself, was 7.67 inches, which being added to the depth which the lake has been lowered, makes a total depth of water pumped out of 10.02 inches; and as there are about 4,113,187 tons of water in each vertical inch, we have a total quantity of 41,214,133 tons of water, which have been actually pumped up to obtain a diminution of 2.35 inches in the depth. Notwithstanding that these results are not so favourable as could have been wished, yet it may be confidently expected that, during this year, very great progress will be made—as the area of the lake now begins to diminish rapidly—and the president said he did not see any reason to change the opinion formerly expressed by him, that the works should be wholly completed in the autumn of 1852.

"Description of a Railway Signal constructed on a new principle," by Mr. John Steven, North British Railway.—The author stated that this signal was intended to be useful in the prevention of accidents, by showing the precise time at which a train has passed the point where it is erected. The necessity which exists for a self-acting signal, which will answer the purpose above indicated, and whose accuracy may be relied upon, has long been felt. Had such signals been in operation on the various lines of railway throughout the kingdom, many of those accidents which have unfortunately resulted in a considerable loss of life might, humanly speaking, have been prevented. As a case in point, reference might be made to the accident which occurred at the Cowlairs station of the Edinburgh and Glasgow Railway in the month of August, 1850. The construction of the signal (a model of which was exhibited) is very simple. The flange of the engine wheel passes over a slightly inclined double lever placed in the inside of the rail. This being depressed, presses down also the end of another lever. By the depression of these levers a perpendicular rod is raised, upon the under end of which is fixed a toothed rack wrought by a pinion. The weight of an index plate, placed on the top of the perpendicular rod causes it to descend slowly and regularly, the motion being regulated by a series of wheels, and capable of being made to extend over a period of ten or fifteen minutes, as may be found necessary. The lever, by means of a weight, is immediately raised to its usual place, after the passing of the train, so as to be ready for giving a fresh signal when the next train comes up. The space through which the rod has descended, and, consequently, the amount of time which has elapsed since the passage of a train, is indicated by a red index plate, which is wholly concealed in a white case when the machine is in a state of rest. For a more detailed description of the signal, reference is made to the larger document read before the Society.

"Description of a method of Printing Letter-Press in Two or more Colours, securing perfect register," by Mr. William Mackenzie, Glasgow.—The author stated that in jobbing, the lines or words to be printed in colour are raised by placing either a strip of pica reglet, or a row of pica quadrats below the types. The black (or greatest surface, of whatever colour) is printed first, in the usual manner, and when faint lines are wanted in colour, high brass must be substituted for leads originally composed in the form. In printing fine book-work, such as the Book of Common Prayer, a small fount, cast a pica taller than the usual type height, is necessary for correctness and expedition. The black is printed first, in the usual manner. The red is printed by taking out the blanks left in the black form, and inserting the words or letters to be printed in red composed with the tall types. The platten of the press must be raised and lowered to adapt itself to the two heights of type, either by placing glazed pressing boards between the drawer and the tympan, or by putting an iron washer of a pica thickness below the piston, when printing the black, and taken out when printing the red.

"Description and Drawing of a Double-Acting Churn," by Mr. Philip Hunter, cooper, Edinburgh.—This churn is so constructed as to possess two motions, a vertical and a rotatory. The former is accomplished by the churn being placed on pivots at its centre, and a rod extending from the breakers inside to the machinery which puts the churn in motion. This rod, by means of a crank on one of the wheels, is caused to move up and down along a rack by the revolution of the wheels, which puts the breakers inside of the churn in motion. By this simple provision the churn itself is made to move in a vertical direction. The rotatory motion is performed by breakers inside the others. It has, however, this peculiarity, that in consequence of the rod moving on the rack the breakers do not move uniformly in one direction, but their revolutions, while the rod moves upwards, are in one direction, but are reversed while the rod moves downwards. This is designed to prevent the milk from assuming a regular and uniform motion in one direction. The machinery is exceedingly simple, and can be put in motion by the hand, by weights, water, &c. The churn can be removed from the machinery (which is enclosed in a box to preserve it) at pleasure; and by removing the rod from the churn the breakers can be taken out and cleaned when necessary.

MONTHLY NOTES.

Clyde Sea-Going Steamers—"City of Manchester," and "Glasgow."—Not very long ago, the citizens of Glasgow had occasion to regret the loss of the Glasgow and New York screw-steamer, "City of Glasgow," which was carried from the Clyde to the Mersey, for the Liverpool and Philadelphia traffic. Since then, Messrs. Tod and M'Gregor have not only built and fitted out the "City of Manchester," as a consort for the "City of Glasgow," but they have now got a third vessel—the "Glasgow"—on her first voyage, as the pioneer of a real

Glasgow and New York line. We append the principal dimensions of the "City of Manchester:"

	Feet	In.
Length on deck,	261	0
Breadth amidships,	36	2
Depth of hold amidships,	25	3
Length of engine-room,	77	7
Length of shaft tunnel,	79	7
Breadth do.	5	0
Depth do.	6	9

Tonnage:—

		Tons.
Hull,		2,109
Contents of engine-room,	770	
Do. shaft tunnel,	29	
		799
Register tonnage,		1,310

She has engines on the plan of the "City of Glasgow," of 366 horse-power. The cylinders are 71 inches diameter, and 5 feet stroke. Diameter of three-bladed cast-iron screw, 14 feet; pitch, 18 feet. The connecting-rods work downwards, and drive a shaft carrying a spur-wheel, 9 feet 10 inches diameter, with 93 teeth, 4-inch pitch, gearing with a pinion of 4 feet 5 inches diameter, and 42 teeth. The teeth in each are in four steps or divisions, each 9 inches broad on the face. She has three tubular boilers, with nine furnaces, and 448 tubes. The keel is of bar-iron, 9 inches by 3½ inches; propeller frame, 7¼ inches; frames of hull, 5 inches by 3⅜ inches, 1 foot 6 inches apart. She has two iron masts, foremast 81 feet long; second, 83 feet, and 2 feet 2½ inches diameter. Funnel, 6 feet 1 inch diameter, and 30 feet long. She will carry 2,004 tons; 1,500 tons of cargo, and 500 of coal. Her crew consists of 86 men, 14 of whom are in the engine-room; and she has accommodation for 180 passengers. On leaving the Clyde, she performed the run to Belfast—109 miles—in 8 hours and 10 minutes, or at the rate of 13 miles per hour. She has a female figure-head, sham quarter galleries, square stern, and is clinker built; a common bow, stationary bowsprit, four masts, three decks, and is barque rigged—port of Liverpool; Commander, Mr. W. O. Campbell. The "Glasgow," now on her way across the Atlantic to New York, is a ship of pretty nearly the same dimensions. Both vessels are several tons larger than H. M. war-steamer "Simoom," which so long ornamented the banks of the Clyde; they are consequently the largest iron ships ever built in Scotland.

International Protection for Literary Labours.—Although we are so frequently reminded, in the proceedings of our legal tribunals, of the extremely unsatisfactory footing on which an author in one country is placed in reference to any other—and although the uncertainty of the law has led to so many collisions amongst the publishing houses, we are still without any remedy for these fraudulent piracies. The French government recently opened negotiations with Prussia, Saxony, and Hanover, with the view of settling the matter by mutual treaty. But what was the result? The German cabinets consulted the booksellers, who consulted themselves and their selfish interests, and replied that France pirated too little from their works to make it worth while to end it by losing the advantage of pirating those of the French. The Saxon government confined itself to recommending the French negotiators first to destroy piracy in Belgium, for the inundations of pirated works from that kingdom—so long as they poured forth—would render the annihilation of the system in Germany of no effect. The Hanoverian minister, more candid still, at once said he did not think there was the least chance of his own, or any other German government, being brought to consent to the downfall of a system which was so profitable to numbers of their subjects; but, with a touch of good nature, he advised application to be made to the Germanic Diet at Frankfort, as possessing authority superseding that of individual cabinets in matters like this, affecting the entire country. From Italy we have no better news. Tuscany, which lately offered most favourably, has gone off altogether. Naples and Rome have too many internal agitations, to attend to anything so unimportant as literature; and the rest of the Italian governments, excepting only Sardinia, regard the whole affair with unmitigated indifference. The possible immorality of the reply of the German cabinets is worth remark, if for one reason only. This very government, on grounds of public morality alone, entered some years ago into treaties with England for the suppression of piracy.

National Institution for Improving the Efficiency of British Artizans.—We have been favoured by Mr. T. Twining, jun., with a copy of the following letter, addressed by him to the Earl of Shaftesbury. We commend its careful perusal to our reading artizans:—"Many years have elapsed since I first formed the idea of an institution, by means of which the manual as well as the intellectual education of artizans, in the more important and difficult branches of trade and manufacture, might receive a finish similar to that which a genteel education receives at the Universities of Oxford and Cambridge. But it is within these last two years that I have been induced to enter more earnestly into the subject, by the cordial encouragement of a friend, thoroughly versed in the applications of science and art, to the advancement of industry, and whose valuable assistance I always feel pleasure in gratefully acknowledging. It is through this friendly medium that my attention has been directed to the efforts made in continental countries to improve the abilities of their respective workmen, and particularly to the successful operations of an institute analogous to the one I had contemplated, by which the Prussian mechanic has been raised, in a short lapse of time, from comparative insignificance to a remarkable degree of efficiency; and it is thus that I have become impressed with the urgency of making counterpart exertions on our side, and with the importance of turning to good account the peculiarly favourable combination of circumstances offered at the present time. Whilst Christian solicitude and prudent philanthropy were looking out for fresh means of improving the condition of the labouring classes, the Great Exhibition has brought into relief a multitude of facts previously unknown or unnoticed, in reference to the true position of the British working man; and it has become evident, that not only as a *sine qua non* of further improvement, but in order even to enable him to maintain his present standing, it is necessary that we should afford him new facilities for developing his natural intelligence and dexterity, that we should strengthen his industry with every appliance that the latest improvements in science and art can contribute, and, in short, that we should neglect nothing that may give him a better chance of coping with his foreign competitors, backed, as they will be, by the increasing efforts of their respective governments. It is, then, proposed—1. That in all large towns throughout the kingdom, and especially in the manufacturing districts, evening schools shall be established, where* journeymen may acquire, during their apprenticeship, such branches of practical knowledge as have a direct bearing on their several vocations. 2. That a sufficient degree of connection shall be maintained between these local schools and the central institute below mentioned, to insure uniformity of purpose, and regularity of working. 3. That a central institute or college, on a large scale, shall be founded under Royal charter, in or near the metropolis,† and sufficiently endowed to secure its permanent efficiency. 4. That journeymen, having completed their ordinary apprenticeship, and who can sufficiently prove their abilities in a preliminary examination, shall be admitted to pursue, as inmates of the college, a regular course of appropriate studies, theoretical and practical. 5. That final examinations shall test their attainments, and that degrees and diplomas shall class and stamp their abilities, for their own advantage, if deserving, and for the security of those who might become their employers. 6. That a museum of industry, similar to the *Musée d'Industrie*, formed at Brussels under the able management of M. Jobard, shall be established at, or in connection with, the Trades' Institute, and steps taken to insure the annual acquisition of specimens, models, or diagrams, illustrating all the latest improvements and inventions which may offer practical advantages.—The interests and exigencies of our artizans are at the present time so well appreciated, that there is no doubt that a committee of leading men, formed for the purpose of carrying out such a plan as the above, of which the main features are doubtless rising spontaneously in the minds of many at the present moment, would find a ready source of financial assistance in the liberality of the public, and especially in the enlightened energy of the manufacturing and commercial community. But it is particularly desirable, as well as natural, that an institution so closely allied to the purposes of the great trades' gathering of 1851, should be fostered by the same illustrious patronage, that a portion of the peculiarly appropriate materials so opportunely brought together within the Crystal Palace, should be turned to account for the formation of the Museum of Industry; and also that the Great Exhibition should bequeath something out of the abundance of its wealth towards the erection and endowment of an institute, which would be so legitimate a monument of its existence and of its benefits. I am at present engaged in preparing a tabular synopsis, classifying, in various points of view, those trades which might be benefitted by the institute, and also a statement, in a suggestive form, of my views, as to numerous details which would have to be considered, in case the proposed plan should be deemed available in its general features.

"T. Twining, Jun.

"Perryn House, Twickenham."

British and American Locks.—The names of Chubb, Bramah, and Hobbs, have lately engrossed so large a space in the columns of the daily press, as to give an impression that there were only two good kinds of locks, and one clever lock-picker at present in the country. How such a notion has arisen, and still more, how Messrs. Bramah should have placed such blind confidence in their lock, as to stand by the result of a thirty days' trial, by a professed picker, is difficult to conceive. It is no disgrace to Messrs. Bramah, that their lock should have been opened, under circumstances which can never occur in actual practice—nay, it may be said, that a lock which took so accomplished an artist thirty days to open, with all the immense advantages which he possessed, has pretty fair pretensions to security. They risked all upon a thirty days' trial. Messrs. Chubb, on the contrary, acted with superior generalship, and offered no reward, being tolerably certain that their mechanism would not stand so penetrating an ordeal; and Mr. Hobbs, well knowing this, picked the locks gratuitously, so as to enhance the public interest in his own lock. The standing of his own lock mainly depends on the failure and ruin of others, and in this way, it must be admitted, that he has made the most of his position. But in all he has accomplished, we find nothing worth while boasting of, for we are confident of being able, at very short notice, to bring forward numbers of practical locksmiths who could accomplish the same thing. As to Mr. Hobbs' own production, will any one who has glanced at the labyrinth of complexities in his Exhibition Lock, not say with us, that such a contrivance can never be commercially valuable? His price is fifty guineas—the price of the recently tested British locks being fifty shillings, and under. But in the midst of all this lock-picking display, it is natural to inquire if this country produces only Chubb and Bramah locks. If our readers will take the trouble to turn back to page 184, of the second volume of this *Journal*, they will find a lock which Mr. Hobbs has been three times challenged to pick, but which he declines to attack, for reasons very easy to explain. This lock is the invention of Mr. Edwin Cotterill of Birmingham, —who offers a twenty-four hours' trial of it—the price being fifty shillings. After disposing of such a test, Mr. Cotterill has further offered to meet Mr. Hobbs on higher grounds, and to make a lock of greater value, leaving him to make his own

* Intending journeymen, we presume.—Ed. *P. M. Journal.*
† Say at North Woolwich.

terms of trial. We have already given our own opinion of this lock, and it is now satisfactory to us to say at this later date, that Mr. Richard Roberts of Manchester, a member of the committee appointed to witness the operations on Chubb's locks, has stated his impression that this lock at fifty shillings is superior to Hobbs' fifty guinea one; being satisfied that the latter could only be managed by Hobbs himself, otherwise it would soon be in a position to defy even its own legitimate key. Most people know the danger and inconvenience attending a permutating lock in going wrong, even with fair usage; and when a lock so simple as Mr. Cotterill's promises to stand a more severe test than even the wonderful complications of the American production, we may reasonably doubt the soundness and commercial value of the permutator. We cannot but admire the sagacity of Mr. Hobbs in not bringing any small commercial locks to this country, equally as much as we must condemn the ridiculous comparison of an expensive and commercially impracticable lock with the cheap everyday production of British locksmiths. In Mr. Cotterill's lock, there is nothing to guide the touch, or the picklock's instruments; consequently, the picker may grope for months, and be no nearer his object than at first. The key cannot be moulded, nor can it be accurately copied by any other means, and the bolts are so arranged that gunpowder cannot be applied to force them back—a peculiar and exclusive advantage of this lock. Notwithstanding all these important points, we should not for a moment think of submitting this lock to a thirty days' test, with the strong inducement held out by Messrs. Bramah. It is well, however, to remember, that Mr. Hobbs objects to attempt it with a day's trial. Strange enough, when he has picked locks of far higher price, by other makers, in twenty minutes.

Working Expenses of the Great Northern Railway.—The number of miles in operation is 236, and the number of miles run by the trains amounts to 1,571,381, and by the engines, 1,689,815, during the past six months. The consumption of coke per engine per mile is 30.9 pounds, costing 2.534 pence; the total working charges being stated at 46.96 per cent. on the gross earnings. The total expenditure gives 1s. 6½d. per mile per train. Up to the 30th June last, £8,274,969 had been received, and £8,069,788 had been expended. This expenditure is made up by £436,223, preliminary charges before the passing of the act; £138,697, law and engineering charges; £1,590,974, land and compensation; £4,411,169, works and materials; £325,640, engines and tenders; £298,593, carrying stock; £591,170, interest on loans and capital; and £69,888, on East Lincoln line.

Maintenance of Way of Midland Railway.—The 483½ miles of this line cost, for maintenance, £124 per mile per annum.

Working Expenses of the Eastern Counties Railway.—The number of miles run by trains during the past half-year exceeds that of the corresponding period of last year by 63,598 miles. The total cost is £55,033, equal to 10.573d. per mile per train, being a reduction in the expenses of £13,581, equal to 3.316d. per mile per train. In the amount of £55,033 is included £3,013 for the use of steam power, for forming the passenger and goods trains, in consequence principally of the great inconvenience of the London stations, which would otherwise be done at a very reduced expense by manual labour. The total cost of the carriage and waggon department for the half-year is £16,748, equal to 3.217d. per mile per train, being an increase of £292, equal to 0.056d. per mile per train. In taking the cost at 10.573d. per mile for locomotive department, and 3.217d. per mile for carriage and waggon department, in comparison with other metropolitan railways they appear high; but by it a very decided improvement has been made in the condition of the whole of the rolling stock. The labour and materials in renewals and maintenance of the line has cost for the last half-year at the average rate of £45. 10s. 9d. per mile, viz., in the renewals £2,172, and in the repairs of stations, warehouses, workshops, and other buildings, £7,130, making a total of £23,966. The one mile at Stratford, that is fish jointed, and has been tested and worked over more than two years, has been maintained at less than £30 per mile per annum, whilst the old road in the same district between Stratford and Bishop's-Stortford has cost in labour, for the same period, £95. 5s. 6d. per mile. It is stated that, by the adoption of the system now in progress, the company may realize, in saving of labour alone, an annual sum of not less than £50 on every mile so completed.

Rolling Stock of London and North-Western Railway.—The number of miles of railway worked by the company is 863½, and the average cost of working stock is stated to be £2,430 per mile. The mileage worked on the 30th of June, 1850, was 794½. On the 31st of December, 1850, 37½ miles in addition thereto were worked, viz.:—Buckinghamshire, 18½; Coventry and Nuneaton, 10; and East and West India Dock line, 9¼ miles. On the 30th June, 1851, 31¼ miles were added to the mileage, viz.:—Buckinghamshire, 2¾; Rugby and Stamford, 13½; Rugby and Leamington, 15 miles; making together at the latter date, 863½ miles worked by the company. The return of working stock shows that it consists of 563 engines, 562 tenders, 1 state carriage, 555 first-class, mail, and composite carriages, 489 second-class, 345 third-class, 24 travelling post-offices and tenders, 259 horse-boxes, 243 carriage-trucks, 208 guards' break and parcel-vans, 41 parcel-carts and trucks, 8,052 waggons, 203 sheep-vans, 14 trucks, 1,155 crib-rails, 5,150 sheets, 162 horses. The increase in the number of engines during the half-year is 10, in the tenders 9, in the first-class, mails, and composite carriages 61, in the second-class carriages 69, in the third-class 3, in the waggons 667, and in the sheep-vans 71.

Lancashire and Yorkshire.—The mileage worked by this company is 287¾ miles. The increase in the receipts, as compared with the corresponding period of 1850, amounts to 17½ per cent., and in the working expenses to 4½ per cent. The average distance travelled by each passenger has been 11¼ miles, and the amount received is 1s. 1½d. per passenger. The merchandise has been conveyed an average distance of 31¾ miles, and the amount received per ton has been 6s. 4d. Each ton of minerals has been conveyed an average distance of 12¾ miles, and the amount received has been 1s. 2¾d. A very considerable proportion of the regular summer traffic to both the east and west coasts, has been diverted by the Great Exhibition.

Cleopatra's Needle and Mechanical Engineering.—With the agitation for the conveyance of this long-neglected gift to this country, from its ignoble bed in the sands of the Alexandrian shores, the mechanical difficulties in the way of its removal have been cast up and examined. It is a mistake, however, to suppose that the hitch rests merely with the engineer's task, it ought more properly to be laid to the account of pecuniary difficulties; for if it comes to a question of possibility of performance, surely that which a race of unmechanical Egyptians could carry 700 miles, 2,000 or 3,000 years back, may now be done by Englishmen, who are backed by all the mechanical appliances of modern times. An apparently practicable hint has been thrown out, that the obelisk should be elevated a few feet from the sand, to allow of the erection beneath of a wooden platform, resting on a bottom of riveted boiler plate. This done, the iron casing being continued up the sides and over the top, would form an air-tight case over the entire mass. Nothing would then remain to be done but to launch it down an incline into the sea, when it might be towed through the water by a steamer. As to its use and position in this country, another looker-on proposes that the great monolith being a "needle," would be a fitting commemoration of the gathering of the works of industry in Hyde Park, and might usefully serve to perpetuate the recollections of the departed glories of the palace of glass. He would erect it on a pedestal of stone of 30 feet high, the four faces to bear records of the flags of all nations, and the four corners to have colossal statues representing industry, skill, science, and art, to be given as orders, by way of prizes, to those competing sculptors who have joined in adding lustre to the Exhibition.

The Great Britain again Afloat.—The *Great Britain* will shortly be once more afloat, having been purchased by Messrs. Gibbs, Bright, & Co., the well-known merchants, to run between Liverpool and the United States as an auxiliary steam-ship. The old monstrous engines have been taken out, and Messrs. Penn are busy putting in new oscillators of 500 horse power, to drive a screw of 16 feet diameter. Messrs. Vernon are the contractors for the iron-work and shipwright's alterations, and Messrs. Mackay & Miller for the deck-house. She is to have a new oak keel, and her bottom amidships will be totally replaced for about 150 feet—the whole floorings being of double angle-iron. The bow and stern are being strengthened by double angle-iron framing, secured by three tiers of iron stringers, 2 feet 3 inches wide, and ⅝ths inch thick, riveted at right angles to the framework. Ten iron kelsons will run fore and aft for her entire length, half as deep again as her old ones; and box kelsons, 3 feet 6 inches deep, will carry the engines. All plates in the least injured are being removed, and extraordinary care is taken to give her the utmost possible strength. By the adoption of smaller boilers, and the erection of a deck-house, 300 feet long, and 7 feet 6 inches high, her stowage will be increased to the extent of 1,000 tons of cargo, whilst she will accommodate 250 first-class passengers. Her six masts are reduced to four, two of which are iron, but even with these she will spread 6,000 yards of canvas. Mr. Patterson of Bristol, her original designer, is the superintendent of the alterations, which are rapidly approaching completion, about 350 men being employed upon the vessel.

The Post-Office.—The first general reduction of postage took place on the 5th of December, 1839—a fourpenny rate being interposed for a short time before the universal charge of a penny. The number of letters delivered in 1839 was 75,907,572. The gross amount of the tax levied upon this delivery was no less than £2,339,737, of which, as the cost of management was only £687,000, there was £1,652,424 carried to the account of profit. In 1850, the letters delivered were 347,069,071, and the penny tax upon them amounted to £2,264,684. The cost of management has, of course, swelled considerably under the new system, though by no means in proportion to the increased service; for whereas the deliveries have been multiplied fivefold since 1839, the expenses are only multiplied about twice and a half, being £1,460,785 in 1850, against £686,768 in 1839. It is worth remark, that the correspondence in the three kingdoms has increased almost equally. In 1839 the deliveries were 59,982,520; 8,301,904; and 7,623,148, in England, Ireland, and Scotland respectively; while last year they were 276,252,642; 35,388,895; and 35,427,534. The amount of money orders issued in 1840, the first year of the system, was £240,063 for England and Wales, £47,295 for Ireland, and £25,765 for Scotland the number of orders being 188,921. In the year 1850, these amounts had increased in England to no less a sum than £7,173,622, in Ireland to £623,732, and in Scotland to £697,143. The total sum was £8,494,498, and the number of orders of which it was composed 4,439,713, showing an average of some shillings less than £2 per order. The number of orders paid in 1850 was 4,431,235, representing £8,483,055. 1s. 10d., so that there is a balance in favour of the Post-Office of upwards of £11,000. The expense of the office in 1850 amounted to £70,577, and the receipts to £73,813.

The Paris Artesian Well.—A late writer on "Paris in 1851," in *Blackwood*, furnishes the following remarks on this well:—Near the *Hotel des Invalides* is the celebrated well which has given the name to all the modern experiments of boring to great depths for water. The name of *Artesian* is said to be taken from the province of *Artois*, in which the practice has long been known. The want of water in Paris induced a M. Mulot to commence the work in 1834. The history of the process is instructive. For six years there was no prospect of success; yet M. Mulot gallantly persevered. All was inexorable chalk; the boring instrument had broken several times, and the difficulty thus occasioned may be imagined, from its requiring, a length of 1,300 feet, even in an early period of the operation. However, early in 1841, the chalk gave signs of change, and a greenish sand was drawn up. On the 26th of February, this was followed by a slight

effusion of water, and before night the stream burst up to the mouth of the excavation, which was now 1,800 feet deep; yet the water rapidly rose to a height of 112 feet above the mouth of the well, by a pipe, which is now supported by scaffolding, giving about 600 gallons per minute. Even the memorable experiment confutes, so far as it goes, the geological notion of strata laid under each other in their proportions of gravity. The section of the boring shows chalk, sand, gravel, and shells, and this order sometimes reversed in the most casual manner, down to a a depth five times the height of the cupola of the *Invalides*. The heat of the water was 83° Fahrenheit. In the theories with which the philosophers of the Continent have to feed their imaginations, is that of a central fire, which is felt through all the strata, and which warms everything in proportion to its nearness to the centre. Thus it was proposed to dig an *Artesian* well of 3,000 feet, for the supply of hot water to the *Jardin des Plantes* and the neighbouring hospitals. It was supposed that at this depth, the heat would range to upwards of 100° Fahrenheit; but nothing has been done—even the well of Grenoble has rather disappointed the public expectation; of late the supply has been less constant, and the boring is to be renewed to a depth of 2,000 feet.

Farm Bridges Impassable for Cattle.—A simple plan of bridge has recently been introduced by Mr. Matthew of Carmarthenshire, for affording an easy means of crossing the wide ditches of low fenny districts, whilst, at the same time, the passage of cattle is entirely prevented. Mr. Matthew uses squared poles with sides of five inches, sawn through diagonally, so that each log forms two triangular beams. These are connected parallel to each other, and laid across the stream or ditch, like a common plank. When open for passing, the poles form a level 14-inch bridge, but when shut by a handle placed on each side, to turn over one of the poles, its upper angular ridge prevents sheep or cattle from getting over. The contrivance is inexpensive, and might be found useful in the Highlands.

ENGLISH PATENTS.

Sealed from 22d August, to 20th September, 1851.

James Palmer, Paddington, Middlesex, artist,—"Improvements in delineating objects, and in apparatus and materials for that purpose."—August 23d.

Edward Clarence Shepard, Duke-street, Westminster, gentleman,—"Improvements in obtaining and applying motive power."—(Being a communication.)—28th.

Thomas Brown Jordan, Lambeth, Surrey, engineer,—"Improvements in machinery or apparatus for cutting, dressing, planing, and otherwise working slate, and also for framing and setting the same."—28th.

James Edward M'Connell, Wolverton, Buckingham, engineer,—"Certain improvements in locomotive steam-engines and railway axles, parts of which are applicable to stationary and marine steam-engines."—28th.

William Johnson, Millbank, Westminster, gentleman,—"Improvements in ascertaining the weight of goods."—28th.

Pierre Armand Lecomte de Fontainemoreau, South-street, Finsbury, Middlesex, and Boulevart Poissonniére, Paris,—"Certain improvements in apparatus for gas lighting." (Being a communication.)—28th.

John Wallace Duncan, Grove-end-road, St. John's Wood, gentleman,—"Improvements in engines for applying the power of steam or other fluids for impelling purposes, and in the manufacture of appliances for transmitting motion."—September 4th.

Henry Alfred Jowett, Sawley, Derby, engineer, and John Kirkham, Peckham, Surrey, engineer,—"Improvements in hydraulic telegraphs and in making signals."—4th.

John Road Drake, St. Austell, Cornwall,—"Improvements in constructing ships and other vessels, and in propelling ships or other vessels."—4th.

Dominique Julian, Sorques, France,—"Improvements in extracting the colouring properties of madder, and in rendering useful the water employed in such processes."—4th.

Baron Charles Wetterstedt, Grosvenor-street, Commercial-road,—"Improvements in preserving animal and vegetable substances."—4th.

William Imray, Milton-road, Liverpool,—"Improvements in the manufacture of bricks."—4th.

Timothy Kenrick, Edgbaston, Warwick, iron-founder,—"Improvements in the manufacture of wrought-iron tubes."—4th.

Benjamin Hallewell, Leeds, wine merchant,—"Improvements in drying malt."—4th.

Pierre Armand Lecomte de Fontainemoreau, 4 South-street, Finsbury,—"Certain improvements in preserving animal substances from decay, by means of a composition applicable to the cure of certain diseases."—4th.

Gail Borden, jun., Galveston, Texas, United States, America, manufacturer,—"Improvements in the treatment of certain animal and vegetable substances, to render them more convenient for use as articles of food, and for their better preservation."—5th.

John Blair, Irvine, Ayr, North Britain, gentleman,—"Certain improvements in beds or couches and other articles of furniture."—11th.

John Rowland Crook, Birmingham, hatter,—"Improvements in hats, caps, or bonnets."—11th.

David Main, Beaumont-square, Middlesex, engineer,—"Improvements in steam-engines and in furnaces."—11th

William Jean Jules Varillat, Rouen, France, manufacturing chemist,—"Improvements in the extraction and preparation of colouring, tanning, and saccharine matters from various vegetable substances, and in the apparatus to be employed therein."—11th.

Alexander Parkes, Birmingham, Warwick, chemist,—"Certain improvements in the manufacture of copper, and in the separation of some other metal therefrom, and in the production of alloys of certain metals."—11th.

George Phillips, Upper Park-street, Islington, Middlesex, chemist,—"Preventing the injurious effects arising from the smoking of tobacco."—18th.

John Wormald, Manchester, Lancaster, maker-up and packer,—"Improvements in machinery or apparatus for spinning and doubling cotton, wool, silk, flax, or other fibrous substances."—18th.

John Simpson Leake, Whitehall Salt Works, Chester, manufacturer,—"Certain improvements in the processes and machinery or apparatus employed in the manufacture of salt."—18th.

John Livesey, New Lenton, Nottingham, draughtsman,—"Improvements in the manufacture of textile fabrics, and in machinery for producing the same."—18th.

SCOTCH PATENTS.

Sealed from 22d August, to 22d September, 1851.

Dominique Julian, Sorgues, Franco,—"Improvements in extracting the colouring properties of madder, and in rendering useful the water employed in such processes."—August 25th.

George Jordan Firman, Lambeth-street, Goodman's Fields, manufacturing chemist, —"Improvements in the manufacture of oxalate of potass."—25th.

Thomas Wilks Lord, Leeds, Yorkshire, flax and tow machine maker, and George Wilson, director of the flax works of John Fergus, Esq., M.P., Prinlaws, Fifeshire, North Britain,—"A machine to open and clean tow and tow waste from flax and hemp, and other similar fibrous substances: and an improved mode of piercing straps and belts for driving machinery, and a machine for effecting the same."—(Communication.)—27th.

Richard Fletcher, Blackdowns Farm, Ebrington, Gloucester, farmer,—"An improvement in obtaining motive power."—29th.

Henry Dircks, Moorgate-street, London, engineer,—"Improvements in the manufacture of gas, in gas-burners, and in apparatus for heating gas."—Sept. 1st.

Richard Archibald Brooman, of the firm of J. C. Robertson & Co., 166 Fleet-street, London, patent agents,—"An improved method of manufacturing screws."—(Communication.)—8th.

IRISH PATENTS.

Sealed from 21st August, to 19th September, 1851.

James Whitelaw, Johnstone, Renfrewshire, North Britain, engineer,—"Improvements in steam-engines."—August 22d.

William Mather, and Colin Mather, Salford, engineers; and Ferdinand Kaselowsky, Berlin, Prussia, engineer,—"Improvements for washing, steaming, drying, and finishing cotton, linen, and woollen fabrics."—September 5th.

David Farrer Bower, Hunslet, Leeds, Yorkshire, manufacturing chemist,—"Certain improvements in preparing, rating, otherwise called rotting, and fermenting flax, line, gaseous, and other fibrous vegetable substances."—8th.

William Johnson, Millbank, Westminster, gentleman,—"Improvements in apparatus for weighing goods."—9th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 23d August, to 20th September, 1851.

Aug. 21st,	2917.	W. Price, Manchester,—"Imperial copying-press."
22d,	2918.	J. Britten, Birmingham,—"A grate."
23d,	2919.	J. Carter, Delabole, Cornwall,—"Filtering apparatus."
25th,	2920.	J. Young, Wolverhampton,—"Flooring cramp."
—	2921.	J. A. Drake, Wells, Somerset,—"An instrument to be used in cases of prolapsus uteri."
26th,	2922.	J. T. Moss, Bayswater,—"Crank spit."
—	2923.	J. and J. Holmes, Regent-street,—"Cloak shawl."
27th,	2924.	H. J. and D. Nicholl, Regent-street,—"A garment."
—	2925.	E. McMorland and Co., St. Paul's-churchyard.—"The pelia or hooded shawl."
29th,	2926.	William Dray, Arthur-street and Swan-lane,—"Turn-rest plough."
—	2927.	W. Hibbert, Manchester,—"Hat."
—	2928.	H. Bowser, Finsbury-pavement,—"Collar."
Sept. 1st,	2929.	G. Beattie, Edinburgh,—"Brick."
—	2930.	Somervail, Brothers, Kendal,—"Improved spring for clogs."
—	2931.	T. T. Read, Hull.—"Improved capstan."
2d,	2932.	S. White, Manchester,—"Improved gas-retort."
3d,	2933.	I. G. Reynolds, Bristol,—"The Februa, or filter-pipe."
—	2934.	G. Boswell, Rickmansworth,—"Ventilating chimney-pipe."
5th,	2935.	A. Marion and Co., Regent-street,—"Pencil-cutter and sharpener."
—	2936.	John Classon, Dublin,—"Royal Victoria ink-holder."
—	2937.	William Healy, Dorset-street, Salisbury-square,—"Portable bath-heating apparatus."
—	2938.	Benedict Barnard, Alfred Rosenthal, and George Burton, Cheapside,—"Pearl edge braiding-machine."
6th,	2939.	Barnard Relge, Finsbury-square,—"German air gun."
—	2940.	John Ranson, Bury,—"Graver-holder for engraving print-rollers."
—	2941.	Edward Davis, Leeds,—"Pressure guage."
10th,	2942.	William Heslop, Barnes, Coningsby, Boston,—"Portable mangle and linen press.
12th,	2943.	William Healey, St. Martin's, Leicester,—"Resilient straps for backs of vests," &c.
15th,	2944.	Joshua Jackson, Wolverhampton,—"Ink bottle."
17th,	2945.	Jesse Shaw, Bishop's-place, Fulham,—"Machine for cleansing currants."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 20th August, to 20th September, 1851.

Aug. 20th,	275.	T. Forbes, Ely-place, Holborn,—"Parallel vice."
21st,	276.	J. Roberts, Portsmouth,—"Paper clamp."
22d,	277.	F. J. Earl, Bermondsey,—"Perpetual calendar."
—	278.	P. Warren, Longton, Staffordshire,—"Danger signal for railways and carriages."
26th,	279.	H. Studdy, Torquay,—"Stoker's ventilator."
27th,	280.	J. Boydell, Regent's-park Terrace,—"Iron support."
Sept. 8th,	281.	Thomas Lewis, Lymington,—"Multiplex coat."
10th,	282.	Julius Roberts, Portsmouth, Lieut., R.M.A.,—"Spur."
12th,	283.	Thomas Humphrey Roberts, Plymouth,—"Drag apparatus."
13th,	284.	Joseph William Lea, Birmingham,—"Match box."
15th,	285.	Peter Warren, Longton,—"Danger signal for railways and railway carriages."
17th,	286.	James Cockings, Birmingham,—"Soirée union back comb."
—	287.	William S. Adams, Haymarket,—"Hinged lid for spectacle-cases and boxes."

TO READERS AND CORRESPONDENTS.

Received.—"Description of an Aerial Pontoon Suspension Bridge to cross the Channel." By B. T. Watts.—"The Paper-Hanger's and Upholsterer's Guide." By J. Arrowsmith.

T. W.—We shall be glad to receive the drawing at his convenience.

We regret to find "A Lover of Truth and Hater of Humbug," so fond of intemperate language. Nothing can be more advantageous for us, than to receive the varied opinions and suggestions of our readers; but when the writers forget themselves, as this "Lover" and "Hater" has done, they must not expect their views to receive much attention.

J. A., Cronstadt.—We are obliged by his tracing, which is quite clear and sufficient for our purpose. There are now seven parts of the fourth volume issued, so that he appears to be very far behind in it. We are sorry to find that he experiences so much difficulty in supplying his wants. If he would take the trouble of communicating with our Publisher, it is probable that some satisfactory arrangement could be made for an early and regular transmission. If we ourselves can in any way assist him, we shall have much pleasure in making inquiries into the matter.

DISCOVERY AND INVENTION.

I.

To discover, or to remove the cover, or veil, from any simple or other fact, or principle, or law, that lies concealed or unknown beneath; to invent, from *invenio*, 'to come at, or light upon'—each word including the idea of finding out a somewhat before unknown,—although synonymous in this respect, each term has, for a long time past, acquired a definite and distinct signification, which, previous to entering further on the important and interesting subject before us, we shall attempt to ascertain, and fix more precisely than we are aware has hitherto been done.

"How to observe," has been the well-chosen title of several elementary works, proceeding from some of the most distinguished persons of the age. They have seen, that by simple observation, all that is valuable in science and art has been brought about; and, indeed, if we look more closely at home, and carefully reflect upon our own status of attainment in everything, we shall soon find that all our individual advances, great or small as they may have been, have been obtained by a succession of stored-up observations, which have gone, however, we may not know how, to produce the sum of the being "I," in the greater certainty or uncertainty with which we feel conscious of being able to judge the works of ourselves and others. Hence the importance of having, in the significant phrase of every-day life, our eyes and ears about us. Every new observation is, in fact, a discovery, for as much as it is relatively worth; and whatever we may falsely imagine or think, he who associates with the word "discovery," the most insignificant thing, stands upon the same platform (though it may not be upon the same dais), as he who first told us of the great Western Continent, or as he who first pointed out to the virgin eye of observation, the remotely wandering orb of the planet Neptune. For after every such accretion to previous knowledge, every one to whom it accrues stands in a new relation to all things; on a higher—minutely so, in some instances, but still higher—eminence, from which he is enabled to take a wider survey of things as they exist in themselves, or as they are connected with surrounding objects. The author of "Cosmos" has even gone so far as to say, that in the observation of a phenomenon which seems at first to stand isolated and alone, there frequently lies the germ of a great discovery.* In a subsequent portion of that work, he in some degree explains the idea that he would thus convey, by declaring that no phenomenon can be examined by an attentive investigator, without being considered in its relation to others.† By reflecting on the subject in the abstract, we readily see how true are these remarks; for individual form, composition, or colour, cannot be known or observed at all, without reference or relation to other individual or general colour, composition, or form. It is, however, the *mind* that has to do the work of observation properly. "I found," says one of the most original writers of the day on Geology, "fragments of the Pterichthys on this first morning, but I date its discovery in relation to the mind of the discoverer more than a twelvemonth later."‡ The philosophy of induction bids us, nevertheless, beware of not running into the extreme on this point; and many are the cautions contained in the great work of the illustrious instaurator of the physical sciences against considering discovery as—to use his own words—"but a species of thought."§ In many matters, more especially in those which relate to experiments we *have* discovered immediately, we think a particular effect will be produced by a new concurrence of circumstances, provided the effect be produced. This is, probably, in consequence of our not being able to conceive a negation, and that what we do conceive at first is the simple action, although it be not yet demonstrated to our consciousness. It has been, indeed, truly remarked,‖ that the guide of all scientific investigation, the uniform essential character of all physical discovery, is to find a unity in diverse appearances, and that by discerning in them a common power acting according to a definite law. On the whole, we may therefore say that the term discovery relates to simple facts, and to laws, as such facts. To discover, therefore, is not difficult, but easy—being, in reality, but to observe and note down; and it is readily seen, that in the infinite variety of nature, and the essential difference of every individual from all others, new discoveries must constantly be being made, although they may not be heeded as such. Discoveries may thus be called expected, or unexpected; for discovery is but a perception of an unexpected resemblance with, or difference from, another thing, particular or general—unexpected in this sense, because, if it be expected, (as it must in these times, in cases where experiment is concerned,) the discovery has already been mentally made. But although the discoverer thus simply points out, with the index of his mind, to the observation of others, the object, be it a law, or a fact of less moment, he has himself observed, he places himself, by so doing, in an almost infinite relation to those others—creating, not merely as it were, but absolutely, a wider universe for them to range in, entirely new to them, in exact proportion to the greater extent of new fact furnished by the discovery.

Having thus suggested, rather than elaborately explained, our view of what is called discovery, we will attempt, in a similar manner, to define invention. As we have seen that discovery goes to make up the sum of knowledge, we may, in the first place, say that invention stands as a figure above this form. If knowledge be supposed to be contained within a circle or a sphere, invention is a something just beyond the bounds; and if we suppose a series of inventions, A, B, C, &c., as soon as A is perfected, it comes within the sphere or circle of knowledge, which must be acquired before B can possibly be *invented*, and so on. Invention is knowledge, *with a springiness*, if we may use a word, ordinarily employed to express the idea of restoration, to convey the idea of rising out of itself. There must be knowledge, and knowledge of the highest kind, *i. e.*, knowledge of simple facts, and knowledge of the laws of fact, to enable one to stand in the position of an inventor; hence the purely scientific mind is very nearly allied to the inventive mind. This truth is more readily perceived, when we particularise the true mechanic among men of science. He knows, above all others—for at every turn he is compelled to know—that we can only conquer nature by obeying her laws. Where one "mechanical power," as it has hitherto been called, is useful, another one would be useless or destructive. He, as well as every other inventor, must have an end in view. The prospect before him, indeed, may be, occasionally, somewhat hazy; but this haziness is produced rather by imperfect knowledge, than *consistent* with the prospect or end itself. For it is ever the more accurate knowledge that leads the inventor along—that necessarily keeps him from straying out of his proper course. Thus is the inventor as often *driven* to his invention, as invention itself supervenes upon his knowledge. This supervention of invention we shall hereafter touch upon, when we speak of the connection between the poet and the inventor. Speaking now of machines, as the more familiar demonstrations of invention, an observant mind, having the particular machine before it, could without great difficulty read in it its own history. The end, or what it is designed to accomplish, is, of course, apparent. We can observe how the chief, and then how the lesser difficulties have been overcome; and, in many instances, how even beauty and elegance have been made to grace mere utility, and all by the adoption of the appropriate means towards the end in view. This may be, more or less, observed in every machine which is viewed with attention; but obviously more in those where necessary complexity of parts produces diversity of ends. We ourselves observed it in M. Claudet's machine for the purpose of cutting with precision, and at little expense, the bottoms of glass shades and cylinders; and in the several envelope-making machines, to which those used by Delarue and Rémond at the Great Exhibition have given general interest. The process of invention, and the rapidity with which one invention succeeds another, is dependent on the mind itself of the inventor. One cannot be always thinking. It is, indeed, a prime part of education

* Cosmos, translated by Sabine, Vol. I., p. 36. † Vol. II., p. 333. ‡ Old Red Sandstone, 117. § Quædam excogitatio, Novum Org. Præf. ‖ A. J. Scott's Discourses, p. 38.

to train the mind to a habit of thought, but it is equally so to school it to the faculty of no-thought. The fallow is beneficial to the after harvest. We know one who began to learn the German language. He was determined to do so at the least expense. He bought a grammar, a dictionary, and a book of exercises, and gave up all his leisure for four months, in the attempt to teach himself. At the end of this time he gave up the task in despair. "It was so difficult, the verbs were so awkward, and the verbal combinations so strange." Well, about two months after this, he happened to call upon a friend, not immediately disengaged; and seeing on the drawing-room table a volume of Goëthe's works in the original, he took it up carelessly, but not so carelessly found he could understand it tolerably well. "Oh, then, I *have* learned something of German," said he; and, renewing his labours, turned himself out as good a "German scholar" at the year's end as he felt it necessary to be. Now, this little episode precisely exhibits the analogous benefit of resting-places to the inventor. The true inventor, indeed, never considers his work perfected. It may appear so to others. This can do him no harm. But he himself rests; and often, after thus resting, surprises the world with fresh evidence of vigorous thought. Those of our readers who are familiar with the Bridgewater Treatises will excuse, for the sake of others the extract we are about to give. Although on so trifling a matter as a toy, there is, in what Dr. Roget said, something so interesting in the process by which he was led to invent the little instrument he refers to, and exactly what often takes place in higher invention—a concurrence of shrewd observation, and that lying by and re-awakening to which we have referred, associated with what is called accident, to which, as it relates to the subject before us, we shall, by and by, advert. "Many curious visual allusions," said he, "may be traced to the operation of this principle (the retina retaining impressions for a certain time). One of the most remarkable is the curved appearance of the spokes of a carriage-wheel rolling on the ground, when viewed through the intervals between vertical parallel bars, such as those of a palisade or Venetian window-blind. On studying the circumstances of this phenomenon, I found that it was the necessary result of the traces left on the retina by the parts of each spoke, which became in succession visible through the apertures, and assumed the curved appearances in question. A paper, in which I gave an account of these observations, and of the theory by which I explained them, was presented to the Royal Society, and published in the Philosophical Transactions for 1825, page 131. About the year 1831, Mr. Faraday prosecuted the subject with the usual success which attends all his philosophical researches, and devised a great number of interesting experiments on the appearances resulting from the combinations of revolving wheels; the details of which are given in a paper contained in the first volume of the Journal of the Royal Institution of Great Britain, page 205. This again directed my attention to the subject, and led me to the invention of the instrument which has since been introduced into notice under the name of the phantasmascope, or phenakisticope."*

This may serve to lead us to some further consideration of the point which we have slightly touched upon. The real nature of improvement, at least in all mechanical appliances, is invention. Such improvement, in fact, is invention, or a species of it; and hence it very often becomes exceedingly difficult to quantitate the honours due to the discoverer, the inventor, and the improver. Thus, with regard to the mariner's compass, who shall correctly apportion the fame due for its introduction, as between the person who first made known the peculiar property of the loadstone, him who first induced that property on an iron bar, and made it float on the surface of a basin of water, and Flavio Gioia, or whoever it was, that improved this rude instrument by causing the "needle" to balance on a pivot? The honour of the invention of the steam-engine does not belong to Watt, who, however, justly claims our regard for those improvements he effected in it, which has made it perform the wonders it now does. In these and similar cases, it may be said that the inventive mind did not choose to be satisfied with what the previous inventive mind had done, but, possessing all the requisite knowledge, it looked still before, and tried and tried, until the trial was successful, in producing a machine which accomplished the end that mind had placed before itself. Invention of this character partakes of what we call imitation, but it is imitation of mode and not of form; and to such imitation, how much really may we owe of what is great and noble, and even original! For, however paradoxical it may seem, to talk of anything imitated being original, when we give to imitation the inventiveness that in these things it really possesses, we readily see that the difficulty of a paradox is obviated at once. Like the discoverer, the inventor must not only see himself, but teach others to see. To the great world he invents not, until this be done; and, of course, observation and argument can only apply to what the inventor thus furnishes. Hence the mere theorist in matters relating to physical phenomena, however he may justly claim the position of a discoverer, is never entitled to that of an inventor. As regards the theoretical character of his investigations, he may, nevertheless, stand in the highest place of invention, as did the inventors of fluxions and the integral calculus, as well as those who, but the other day, invented the inverse method of making their calculations, and thereby pointed out to the observer a planet never before seen by mortal eye.

Invention, then, is result. It consists not in things wholly new, but in the new combination or adjustment of things old. The mistake which many make in supposing the contrary, arises from ignorance of the process employed in invention. We see the thing invented perfect; but we have not seen the many and circuitous roads which all the parts composing it have gone over, much less the multitude of twists and turns, rejections and new experiments, which have taken place after the first conception; and much less still, that subtle gradation of reflection which was primarily crowned with the original thought.

Invention in all art—in painting, sculpture, poetry, and argument—partakes of the characters we have thus ascribed to invention in physical matters. Reflecting thus, we readily perceive how all noble invention must depend on truth as its prime support. An original and powerful modern writer has said, with a freedom and correctness of vision which, unfortunately, is as rare as it is clear, that, perhaps, if we consider well, the highest exercise of invention has, in very deed, nothing to do with fiction, but is an invention of new truth—what we can call a revelation.* This is high ground to take for the inventor, certainly; but many shrewd and observant minds have thought the same thing, though they may not have expressed themselves so plainly. "Invention," said Fuseli, "in general, is the combination of the possible, the probable, or the known, in a mode that strikes with novelty;"† and, in another portion of his volumes, he goes on to explain more his meaning, by saying that it discovers, selects, combines the possible, the probable, and the known, in a mode that strikes with an air of truth and novelty at once;‡ and suggests that the imitation of nature is the real sphere of plastic invention. It will be perceived that, by independent reasoning, we have made these particular conclusions, at which he had arrived in contemplating the arts over which he presided, applicable to invention in general. Authors of every calibre hint, if they do not positively assert, the same thing; and it is to be found even in the very romance of scientific literature. Thus Mr. Davies, the self-styled Poughkeepsie seer, is alleged to have asserted, in one of his trance-lectures, that inventions are "mere imitations of nature, and applications of principles therein contained. Nature, in a mechanical respect, is acting in a perfect way; while man's inventions are but an imperfect representation of the same. Consequently, there is no invention—no creation of principles—no forming originally what has not primarily existed; . . . . where forces are combined and developed in

* Third Edition, Vol. II., page 466, note.

* Carlyle's Miscellanies, Second Edition, Vol. IV., page 18. † Aph. 48.
‡ Ed. 1831, Vol. II. p. 137.

the various machines which [the true mechanic] constructs, he only finds them to be an imitation of some great principle which nature originally and eternally contained."* "What is invention," exclaims Mr. Whewell, "except the talent of rapidly calling before us the many possibilities, and selecting the appropriate one?"†

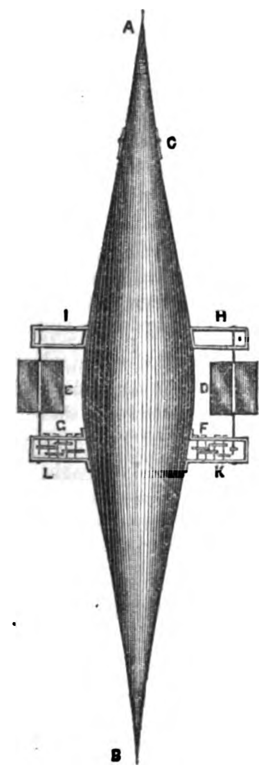
On the whole, we may say, then, that invention simply relates to *means towards an end*, or to *operation of law upon fact;* and so far as any such result is new, so far does invention partake of the nature of creation, in the precise sense in which that term may alone be conceived by us; and invention may, in such sense, be considered analogous to the introduction of new species of living things into the *flora* and *fauna* of the earth.

ON A METHOD OF SOUNDING IN DEEP SEAS.

By J. P. Joule, Esq., F.R.S.

The impracticability‡ of sounding the depths of the ocean by the ordinary plumb-line, has been remarked for nearly three centuries, and, during this time, numerous inventions have been proposed and tried for the measurement of the vast profundities of the sea. Of the varieties of these inventions, apparently the most satisfactory plan was that in which two bodies of different specific gravities were let down in connection with each other, and, on arriving at the bottom, were detached, to permit the lighter one to rise to the surface of the water. With this test, the time occupied by the ascent was taken as the index of the depth; which was also otherwise ascertained from indices actuated by the revolution of vanes, propelled by the motion of the sounding apparatus through the water.

Fig. 1.



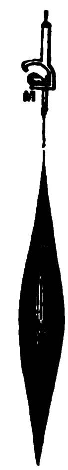
1-24th.

In apparatus of this class, the body used as the rising float was generally of wood; and it is easy to see that, beyond a very limited depth, such a material is quite inapplicable for the purpose; for Scoresby and others have long since shown, that when wood is sunk to a great depth, it becomes so saturated with water, that its specific gravity is increased beyond that of water itself. To overcome this difficulty, pitch and other fluid repellant compositions have been used to cover the wood, but it may still be doubted whether such a coating would prevent the penetration of the water under great pressure. I find, moreover, that light wood, and even cork, when subjected to a pressure of some tons on the square inch, are crushed so as to become specifically heavier than water; and that they remain so, even after the pressure has been removed. A wooden float would therefore be crushed, even if the external pitch coating were sufficient to keep out the fluid from its pores.

A plan for overcoming this difficulty has been recently devised by M. Faye, who substitutes a vessel of sheet steel, filled with oil or some other light inelastic fluid, for the wooden float. He recommends the use of a cylinder of sheet steel, one meter high, and two decimeters in diameter, which, filled with potato oil, would have a specific gravity of 0.88 in comparison with sea-water, and a force of ascension equal to fifteen kilogrammes.§

I believe it to be impossible to improve upon the general principle adopted by M. Faye, but it has occurred to me that a great improvement would be effected in the detail, by substituting, for the metallic vessel in his apparatus, one of gutta percha. Such a float filled with alcohol, or a light oil, need not exceed the specific gravity of 0.8, that of sea-water being called unity. In this case, the ascending force would be nearly double that of M. Faye's instrument. As a further means of increasing the velocity of ascension, it should be constructed on Mr. Russell's wave principle. If the float were 8 feet in length, and about 1 foot at its greatest diameter, a depth of seven miles might be sounded in less than an hour.

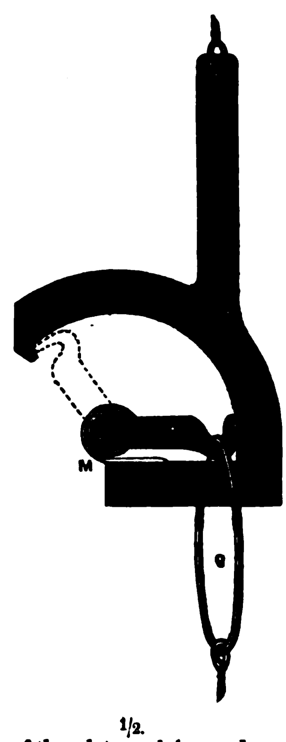
Fig. 2.



1-24th.

Fig. 1 of the annexed illustrations is a side elevation of my proposed float, being a hollow vessel of gutta percha, filled with a light incompressible fluid, such as oil of potatoes, or alcohol. The sides of the vessel should be about an inch thick. At the extremities, A and B, are copper caps, to give rigidity and protection; the upper cap, A, being made to unscrew, to allow of pouring in the oil. At C are copper eyes, for the purpose of raising the float out of the water when required. On each side of the centre is a vane, D E, of light steel, set to revolve in opposite directions, making one turn for each three or four yards of the space traversed by the float. The wheel-work at F G registers the distance traversed. In descending, the resistance of the water causes the spindles of both vanes to work upon the hard steel plates, H I, the opposite ends of the spindles revolving in guide holes. In ascending, the spindles work upon similar plates at K L; the vane, E, registers the distance in the descent, and D in the ascent. At the end, B, is attached a copper wire about 30 yards long, and to the other end of this a spring, M, is attached, as in fig. 2, for the purpose of disengaging the cast-iron weight, N, the instant it touches the ground. This figure represents the weight, with its disengaging apparatus, detached from the float; the two figures being on the same scale, the relative magnitudes of the float and weight may be easily made out. Fig. 3 is a side view of the disengaging apparatus above, on a larger scale. It consists of a sort of curved forked link, having a catch or detent lever, P, jointed to an eye on its lower limb. Over the notch in this lever, when the latter is bent down over against the action of the spring, coiled round its stud, is placed the loop of the copper wire, Q. A pressure of about ten pounds is sufficient to keep down the lever; but the moment the weight, N, reaches the ground, the spring brings round the lever to the position indicated by the dotted lines, thus throwing off the wire loop from the lever, and releasing the weight. The float then at once ascends to the surface, when the depth may be at once read off upon the index. Both the float and weight are shaped to the wave line curve, to diminish the fluid resistance as much as possible.

Fig. 3.



1/2.

As it would be exceedingly interesting to ascertain the nature of the ground at the bottom of deep seas, I have appended some sketches of a plan whereby a small portion of earth may be carried up by the float to the surface. Fig. 4 is a side view of the apparatus, 1-24th the natural size. The thin open steel-plate, A, forms the suspending medium for the two weights, B, hung from disengaging arms, C, on each side of the plate. When sunk, of course the weights become detached at the instant they come in contact with the ground, but the momentum of the plate and iron rod, D, in the centre, forces the lower sharpened point of the latter into the ground. Fig. 5 is a half-size view of this detail of the apparatus. The sharpened termination, D, is in the form of a hollow cone, and when drawn out of the ground by the upward action of the float, the collar, E —composed of gutta percha, plugged with metal, so as to be of the same specific gravity as water—is forced down on the top of the cone by the resistance of the water, securing within it any silt or sand which may have been collected within it.

Fig. 6 represents another arrangement for accomplishing the same end. Two hollow hemispheres, A, of tempered steel, are attached to the lower ends of the two springs, B, and the latter are again riveted at their

* Vol. I., pp. 86-7.

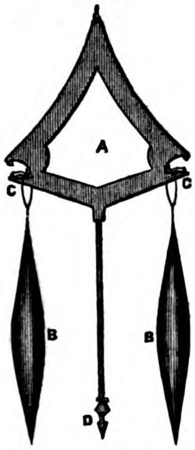
† Phil. of the Ind. Sciences, Vol. II., p. 221.

‡ I am aware of the extensive series of soundings undertaken by the Government of the United States, from which it has been alleged, that an ordinary plumb-line may be successfully used to sound a depth of 4,000 or 5,000 fathoms. But it must be obvious that the great resistance offered by the water to so great a length of twine, as well as the currents which may and do exist beneath the surface, are sufficient to render the American mode quite incapable of furnishing results to be relied upon with confidence.

§ *Comptes Rendus*, January 20th, 1851. I had some years previously imagined that a float of sheet copper filled with oil would be successful, but I delayed the publication of my plan in the hope of being able to prove its utility by actual experiment.

upper ends to the hollow cylinder, C, sliding easily on the iron rod, D. The hemispheres are kept asunder by the two arms, E, but so soon as

Fig. 4.

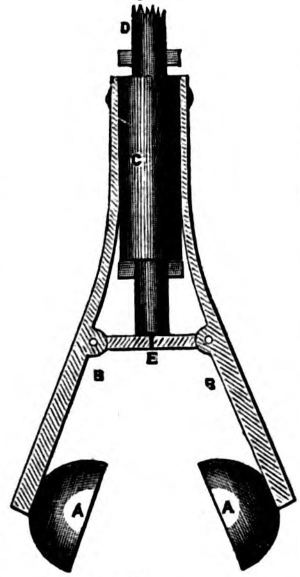


1-24th.

Fig. 5.

1/2.

Fig. 6.



1/2.

the hemispheres strike the ground, the arms, E, are forced down by the lower end of the rod, D; and being set to act in a straight line, to distend or bend out the two springs, B, the downward pressure of the rod, D, releases the points of contact, and the springs bring the two hemispheres together. This contact is effected with considerable force, and the two scoops thus take up and enclose some particles of earth for conveyance to the surface.

Acton Square, Salford, Sept. 1851.

EPITOME OF AMERICAN INVENTION.

IV.

Cotton Harvester.—The principle of collecting the cotton from the seeds, as used in the cotton gin, is here applied to collect the cotton from the bolls, and to separate it from the leaves and stalks and other refuse matter of the plant. In its general construction, the machine consists of an oblong frame on a pair of wheels, to be drawn by a horse or horses travelling between the rows, the wheels running astride one of the rows. The machinery for collecting the cotton is placed midway between the wheels, and receives the bolls of the plant as the machine moves forward. For this purpose a channel or passage is made from the front to the rear, through the middle of the machine, extending as high up as the axle-tree, and is floored over above it. This passage is wide at the front to take in the whole of the plant, and gradually narrows as we approach the axle-tree, and from thence to the rear the width is uniform. In the anterior portion of this passage, the sides converging collect the cotton bolls together, where they are caught by the teeth of the pickers. On each of these sides is placed, in the anterior or converging portion, a broad disc of a wheel, extending from near the ground to the upper part of the machine, having its disc covered with teeth like those of a saw, set obliquely and in one direction, which rotate with rapidity, and seize the bolls of the plant as they enter the passage, and tear out the cotton. Should any of the cotton escape the first set of pickers, there is a second pair near the rear of the machine, where it will be collected in the same manner as before described, except that the teeth in this case, instead of being on the disc of a wheel, are placed on the periphery of a vertical cylinder, and carry the cotton around upon one side, where the fluted strippers clear it, and deposit it in a box. This machine, as before mentioned, is the first of its kind presented to the office for a patent; it will, of course, be improved. The practicability of this machine for taking the place of the present mode of picking cotton, considering that the machine must so tear to pieces the bolls, whether ripe or not, so that the cotton can never be picked but once—and how this can be reconciled with the present practice of picking two or three times, which is founded on the fact that only a part of the bolls ripen at a time, are questions to be settled by the cotton planter, and not by the office. Perhaps the first picking may be done as usual by hand, and the last by the machine, and thus the power-picker, when it shall be improved, subserve a valuable aid to the planter.

Printer's Ink.—Linseed oil and lampblack are the well-known ingredients of printer's ink, and the preparation is necessarily attended with a tedious, disagreeable, and dangerous process of boiling and burning, in order to give the ink the peculiar tenacity required. The invention here set forth consists in the introduction of a new oil, not before used for such purposes, and thus modifying the process, so as to obtain an ink of a superior quality, without the dangerous process of burning. Considering the large amount of this material used at the present day, and the comparative cost of the two oils, (the expense of the linseed being four times that of the rosin oil,) this invention assumes an importance in the improvements of the day not usually met with. It is also stated that the introduction of this oil enables the printer to print with delicate and fancy colours, which cannot be done with ink manufactured from linseed oil. The oil here referred to, and called *rosin oil*, is obtained by the destructive distillation of common rosin. The process was patented some five or six years ago by W. T. Clough. This oil is extensively used in paints, and has been recently introduced for the manufacture of illuminating gas. It is this oil which furnishes the gas to light our streets, houses, and the public buildings of this city.

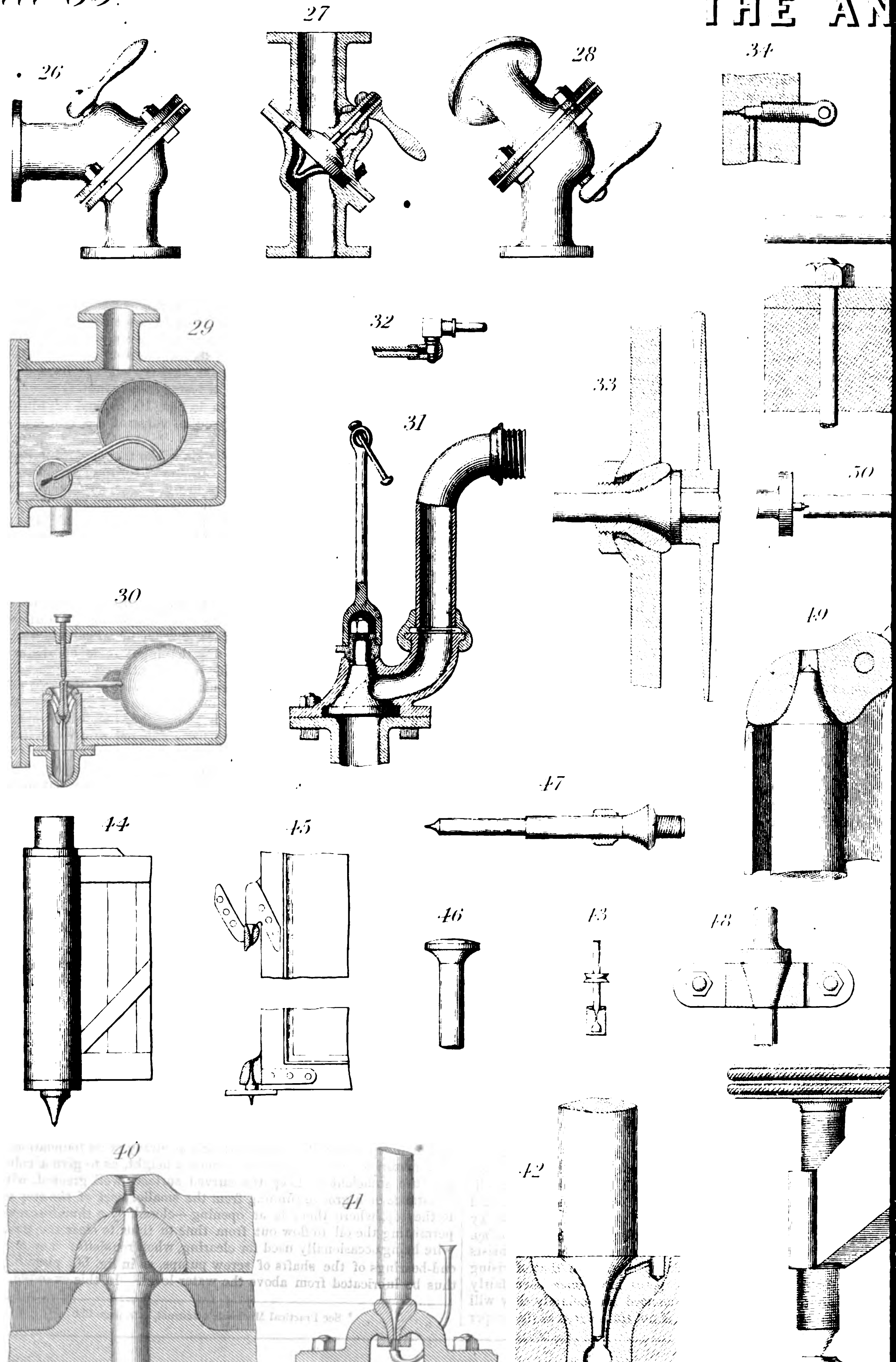
Preparation of Metal Patterns for Casting.—A process has been patented for reducing and working into the desired shape and form iron-castings, to be used as patterns for moulding for other castings. It consists in acting upon the cast-metal with dilute oil of vitriol, until the metal of the exterior parts is nearly all dissolved out, and thus presenting a substance chiefly plumbago, easily worked with tools, and which may be planed and worked into the proper shape, while the internal parts retain a sufficiency of metal to give strength to the whole.

Coating Iron with Copper.—This consists mainly in the device for protecting the iron while it is being immersed in the melted copper. The iron having been cleaned and prepared in the usual manner with dilute oil of vitriol, is quickly dried and immersed in a thick cream of clay and water, and again quickly dried, and with the covering of clay upon it suddenly depressed in the bath of melted copper, by which the clay flies off and the metals firmly combine. A coated iron plate is thus formed, that is susceptible of many and valuable purposes in the arts.

Illuminating Gas.—The peculiarity of this invention consists in the use of a mixture of charcoal and iron scraps, heated to bright redness in an iron retort, through which pass the gases generated by passing steam through red-hot charcoal. It is proper to say, that when steam is passed through highly-heated charcoal, the oxygen of the water unites with a part of the carbon and forms carbonic oxide, while the hydrogen unites with more carbon and forms light carburetted hydrogen. Both of these gases are combustible, but neither furnishes any considerable illuminating power. But it is alleged by the inventor, that when these gases, and especially the hydrogen, is brought into contact with carbon and iron at a red heat, the light carburetted hydrogen is converted into olefiant gas, or heavy carburetted hydrogen. It is now about twenty years since apparatus was constructed for the preparation of illuminating gas from decomposed water mixed with other hydro-carbons. The first attempt was by mingling spirits of turpentine with the gases derived from water at the burner. See the English patent of Michael Donovan, sealed 6th October, 1830. The next step in the improvement consisted in the mixture of the gases from the decomposition of water with volatile oils, while on their way to the burner. The oils were thrown into the pipes in the state of vapour. This improvement, made by Jean Baptiste Mollerat, was set forth by the inventor in a patent, sealed in England, 25th Sept., 1834. The same gentleman made another modification of his apparatus, as shown in his second patent, sealed May 2d, 1837, in which it is stated that the gist of the invention consists in bringing the gases generated from steam into contact with the volatile products of oil at a high temperature. In 1840, Count de Val Marino exhibited in England a further improvement in gas generators, a patent for which was sealed 22d June, 1839. It consisted of three cylindrical iron retorts, standing on end in a row in the furnace. In the first it was alleged that the steam was decomposed into carburetted hydrogen and carbonic oxide; in the second, the gases were more highly carbonized, and in the third, brought into contact with the volatile oils, when in the act of being converted into gases. In the first retort are placed sufficient carbonaceous material to decompose the steam; in the second are contained pulverized charcoal and other carbonaceous matter, to more highly carbonize the gas; and in the third, fragments of coke or other carbonaceous matter, amongst which the gases from the second retort are received, and on which the oil or other gas-making liquid is allowed to fall in drops or fine streams. Such was the state of progress in this department of the arts when the invention under consideration was presented for a patent in England,

Plate 83.

THE AN



...inson, Patent Offices,

and was sealed April 15th, 1847. Mr. Stephen White, the patentee, also employed the three retorts used by Val Marino, but confined himself to the use of two for decomposing the steam and carbonizing the gases from it. In the first two he placed abundance of carbon, consisting of pulverized charcoal mixed up with scraps of iron or iron turnings, for the purpose of rendering the gas more highly charged with carbon. The substance of the invention in this case consists in adding the iron turnings to the carbon in the first two retorts. The claim in the English patent above refered to, covered many points not material to the main feature of the improvement, which consisted in the use of iron fragments contained in a colander placed in the middle of the retort, or the use of lime in place of the iron. In the American patent of Mr. White, granted January 22d, 1850, on the English patent sealed 26th March, 1849, the claim is based upon the use of the iron in combination with the carbon. In reviewing the subject of the processes and materials for generating illuminating gas, where the elements of water are brought into contact with highly-heated pulverized carbon, and, as appears by the results, made to absorb a considerable amount of carbon, so as to give them a luminous body, so to speak, there seems to be a great dearth of definite information. Nearly all the persons who have been engaged in improving the processes and the apparatus, do not appear to understand the precise nature or the desiderata of their experiments. Mr. White says, in his specification of his English patent for 1847, that the effect of his iron plates, used with the carbon, is to absorb the carbonic acid gas generated in the gas evolved from steam. I have recently repeated the experiments of Mr. White, and have been enabled to prove that no carbonic acid does or can exist where the elements of water, or where oxygen, or air, or carbonic acid, are allowed to pass through or over pulverized carbon at a red heat; any of these elements, except the carburetted hydrogen, will be instantaneously converted into carbonic oxide. From what has been done by my own and others' experiments, I have learned the following: that whenever light carburetted hydrogen, or pure hydrogen, or carbonic oxide gases, either separate or mixed with each other, are passed over highly-heated pulverized charcoal, a great excess of carbon is taken up and rendered volatile, and held in combination with the gases, communicating to them a considerable degree of illuminating power; but the quantity of carbon taken up depends on the degree of heat and on the surface of the carbon presented, so that it is a difficult matter to so guage the quantity of carbon taken up as to produce a uniform and equable light. It is found, that when any of these gases has been charged to excess with carbon, if it be passed over or through iron chips or fragments heated to moderate redness, the metal will take up the excess of carbon, and yield a fair illuminating gas of a pretty uniform composition, and this, mingled with the ordinary oil or rosin gas, constitutes the basis of all the processes now before the public for water gas. Mr. White used the carbon and the iron in the same retort; others use the materials in two different retorts, and force the gases first into the carbon retort, and then into that containing iron.

Boots and Shoes.—A patent has been granted under this head, for a combination of devices for cutting boot heels. It consists of an inclined plane or bed piece, and two curved cutters or chisels, for cutting the two symmetrical sides, and half of the back. The cutters work in guides with machinery to depress them, so that the heel or several lifts may be cut at a single depression of the chisels. The guides are so arranged, that as the chisels descend they expand or separate, and produce the expanding form of the heel, from the bottom upward. A patent was also granted for a metallic spring boot heel of the usual contour and form. It consists of an outer case or ring of metal, and of a corresponding piece received within it, and easily sliding in and out; but when in its proper position, projecting beyond the case. It is sustained in its place by means of a spiral spring under the central portion of the cap. Perhaps a clearer idea may be obtained from the claim, which is, "making a metallic tread for the heels of boots and shoes, separate from, but secured within, the casing of the heel, in such a manner that it shall be free to change its position, to accommodate itself to the inequalities of the surface of the ground, whereby it wears more evenly, and is less fatiguing to the foot than a rigid heel."

Tanning.—A patent has been granted for a modified process in tanning leather, which is specially applicable to light skins, but may be used in all kinds of tanning. The gist of the invention consists, first, in a modified process of unhairing the skins, by a composition of lime, potash, and salt, by which the process is very much shortened; and secondly, by combining what is called the process of *plumping* with that of *tanning.* It is alleged by the patentee that the process of plumping, which consists in the use of acids, to open the pores of the skins, is like that of rising dough by yeast; namely, that after the pores have once been fairly opened, if the tanning process is not commenced immediately they will soon begin to close; as dough once raised, if not transferred at the proper time to the oven to be baked, will fall, and an inferior bread will be the result. The process of tanning, therefore, as set forth by the inventor, consists in the combination of the plumping and the tanning process, so that as soon as the acids have acted to open the pores of the skins, the tanin present in the liquor shall enter and perform its part in the operation.

MECHANICAL APPLICATIONS OF THE ANTI-FRICTION CURVE.

II.*

(Illustrated by Plates 81, 82, and 83.)

In again referring to plate 81, of the illustrative theoretical figures of the anti-friction curve, we may, in the first place, beg the reader's attention to the remaining figures upon it, which are yet undiscussed. These figures afford very conclusive evidence of the exceedingly slight and uniform wear of revolving surfaces formed in accordance with the new curve, as compared with similar rubbing surfaces set out in the ordinary way. This evidence, let it be remembered, has nothing to do with the mere theory of the effect of the curve surface, but has been deduced from the direct practical experimental tests of the inventor.

The simple test apparatus shown in figs. 10, 11, and 12, illustrates, in a very remarkable manner, the peculiar value of the new contour in reducing friction.

Fig. 10 is a vertical sectional elevation of the test apparatus, and figs. 11 and 12 are sections of different contours of working surfaces, corresponding and fitting to the apparatus in fig. 10. The frame of the instrument has a small winch-handle spindle working in a journal, *a*; and at the top of the frame a hole is drilled through its centre, *a*, so that a pin, *c*, may transmit the strain given outside by the nut, *d*. There are two small holes, *e*, in the inner end of the spindle, for the purpose of receiving catch pins. A variety of frictional contours of equal diameters, turned out of a single piece of cast-iron, carefully annealed, were subjected to test in this apparatus under various degrees of pressure, and this pressure being applied from the two ends, was perfectly equal on each of the surfaces experimented upon. In all of them the clean dry metal surface was used. The one marked *f* is the common disc, having a guide on the outside. Another, *g*, is a disc, having its guide in the centre. The surfaces, *h* and *i*, are respectively spherical and conical; and *k*, *l*, *m*, are anti-friction curves. The old well-known forms usually showed a smaller amount of friction when commencing to work, but when they had been subjected to frictional wear for some time, the surfaces adhered firmly together, the curved part being carried round; and this, once in motion, never stopped again to give the advantage to the other, as it directly improved by the least wear. This result is obvious, when it is considered that the mean circle of revolution is less in diameter than that of any other surface. Besides this, an important point exists in the large surface of the curve, whereby a smaller diameter may be taken. It is clear that this one point must effect a reduction in the friction, and add to the accuracy of the movement.

When it is thus easily shown that the systematic shaping of all revolving frictional surfaces, sustaining any pressure whatever in the direction of their axes, produces economical advantages of so valuable a nature, it may well be understood how difficult it is to enter into and individualise the mass of its obvious applications in practice.

Pivots and Footsteps.—For pivots and footsteps, the extremity of the upright shaft is turned to the curve, and being set in its proper position, soft, easy-flowing, or anti-friction metal is then poured into the step-box, and a groove is cut down the curved surface of the step, a large aperture being made beneath as a receiver for dirt, which may, from time to time, be pushed through the groove with a wire, whilst provision is made for the deposition of the impurities of the oil, before coming in contact with the working surfaces. For pivots where excessive accuracy is required, and upon which there is an unusually great strain in proportion to the rubbing surface, a step resting with a spherical surface upon the support is used, so that it may give way freely to any vibration, and be independent of the strength and accuracy of its foundation. The oil for lubrication is supplied from such a height, as to give a columnar pressure sufficient to keep the curved surfaces well greased, with the assistance of a groove running from the smaller part of the step nearly to the top, where there is an opening—closed by a thumb-screw—for permitting the oil to flow out from time to time to clear the groove, a wire being occasionally used for clearing, when requisite. The pivots or end-bearings of the shafts of screw pumps, as in fig. 56, plate 83, may thus be lubricated from above the water-level. In this example, as in

* See Practical Mechanic's Journal, *ante*, page 132.

others where there is a side strain, the groove in the step ought to be opposite to the strain. It is hardly necessary to mention the important effect of this curve for the pivots of astronomical instruments, and, more particularly, as no lubrication is necessary for it in such applications. In turn-tables, the main weight may safely rest on this form of pivot, which allows of such adjustment, as entirely to remove the disagreeable noise and jar so well known at railway stations.

Axes.—In adapting the curve to axes of various kinds, its peculiar advantages are very clear, inasmuch as, by dividing it into two parts, with a parallel bearing between both bearings of the curve, it acts with great accuracy, and with perfect conformity with the exigencies of the case. Where economy of space is important, the division may be made, but with the parts contracted.

Journals.—The disadvantages existing in the valuable lathes with cone bearings, arising from the tendency to stick, may be effectually removed by modifying the cones to the curve surfaces. In upright shafts, such surfaces may be tightened up by adjusting the bearings up or down according to the direction in which the taper is set; the wearing out of the bushes does not interfere with the accurate working of the shaft, as the bushes may be turned round. When adapted to shafts and spindles for transmitting angular motion through casings, as in screw-propeller shafts, at the part where they enter the water, or in spindles for actuating the regulators of locomotives, the attention so necessary in a stuffing-box is not required, nor is there the same liability to stick or leak.

Collars and Shoulders.—In friction couplings, where the lever acts against the collar of the loose parts, and where a collar prevents a shaft from yielding to lateral pressure, the curve promises to reduce the consequent friction to a very great extent; whilst, in the ordinary cone coupling, the regularity of wear keeps the surfaces true, and allows of their being set with an angle, which prevents sticking. The action of screws for connecting two parts of a piece of machinery together is frequently stiff, owing to the square bearing of their heads against the compressed part; but with the new curve, the screws may be tightened up with great ease and accuracy, leaving the greatest possible strength in the screw—a point of leading importance in such cases—as the connection of rods for boring Artesian wells. Axle-trees for great loads on bad roads are at once pointed out as good examples for the modified form of bearing surface, so also are railway axles, where curved collars are always used, but under no definite rule of formation. In hand-presses, the collar which raises the top plate very frequently works stiff, with a tiresome checking action; and the same thing occurs in the collars of hanging shafts—both difficulties, it would appear, are now removeable in a very simple manner.

Screws and Threads.—Mr. Schiele's rule affords a definite guide for the uniformity of construction of the frictional portions of screws and nuts to work with a minimum of friction, as the curve itself tends to retain the screw in the centre line. Nuts are easily cast round the screws, the metal flowing with ease and certainty between the threads.

Cocks and Valves.—We here touch upon a decidedly sore point in mechanical construction, and one for which a remedy has been sought in almost every conceivable shape of parts. Every one is acquainted with the disagreeable looseness and gradual deterioration of such surfaces, as well as with the overpowering friction arising from their forcible tightening up—defects common to all classes of revolving valves. With the new form, the contact surfaces are, in most cases, tightened by the very pressure of the steam or fluid whose flow they command, and provision is made to prevent unequal wear from the openings through the surfaces. The modification to which the name of universal cock has been given, admits of application to nearly all situations and sizes. One and the same cock may be applied in a length of straight piping, or in any angle down to a right angle, in which the flanges may stand. In ordinary cases, the valve only is brass, the shell being of cast-iron. The same kind of valve is also applicable for self-acting feed-regulators for boilers, limiting the range of the fluctuation of the water-level to half an inch, and thus removing one grand source of boiler explosions. The advantages of the conical lower surface for safety-valves, to which we drew attention last month, at once point to the anti-friction curve, or modified cone, as a philosophically accurate remedy for all the train of evils connected with the sticking of the contact surfaces, and the throttled escape of steam. Such a figure balances completely on the issuing vapour, whilst the steam finds its way out equally all round.

Grinding Mills.—Our plate 66, *ante*, has fully illustrated the application of Mr. Schiele's invention for the grinding surfaces of mills, as well as for the shaft bearings. The grinding surfaces are brought to the correct contour by grinding sand or stones between them, so that the nice system of dressing essential for the accurate working of the plane surface-mills is dispensed with. The frame on which the mill rests forms the box to receive the manufactured flour; and, during grinding, this box is partially exhausted by a ventilator, to produce a continuous draught between the stones, keeping them cool, and drawing down every particle of flour as soon as it is sufficiently reduced. The circulation of air is so contrived as to separate the dust before it reaches the ventilator; this contrivance is also suitable for dressing.

To complete our illustrative examples of the workshop applications of the curve, we now give the following

Reference to the figures in Plate 83.

26, 27, & 28, UniversalCock, adjustable at any angle down to a right angle.
29 & 30, Condensing Water-Trap.
31, Fire-Cock—Stand-Pipe fixable in three different directions.
32, Turning Joint of Gas-piping.
33, Journal of Screw-propeller.
34, Stop-valve for Hydraulic Pump.
35, Browne's Registered Bath, or Three-way Cock.
36, Turning Joint for Pipes of Oscillating Engines.
37, Axis for Astronomical Instruments, also applicable to Swing-bridges.
38, Contracted Axis.
39, Expanded Double Axis for Theodolites.
40, Pivot for Turn-tables.
41, Do. for Shafting.
42, Do. with Anti-friction Metal.
43, Pivot for Spindle of Spinning Machinery.
44, Do. for Sluice Doors.
45, Do. for Doors and Windows.
46, Do. for a Hanging Shaft.
47, Do. for a Journal for Lathe Spindle.
48, Journal of an Upright Shaft.
49, Top Pivot of a Crane.
50, Centres of Lathes.
51, Castor.
52, Cart Axle-tree.
53, Joint of Rods for boring Artesian Wells.
54, Screw Collar.
55, Water-crane for Railway Stations.
56, Pivot for Archimedian Screw.
57, Screw, Pivot, and Collar for Presses.
58, Friction Coupling and Collars of Shaft.
59, Worm and Wheel.
60, Screw-Jack.
61, Hand-Mill.

THE PRUSSIAN NEEDLE GUN.

Amongst the novelties which the Exhibition has assisted in bringing prominently forward in this country, the invention in fire-arms, popularly known as "Sears' Needle Gun," is to be regarded as a great curiosity in the history of the mechanism of projectiles. The tale of its wonderful performances, and even our earlier modest report* of its capabilities, was long held to be somewhat apocryphal, until the Government trials at Woolwich, and Lord Ranelagh's Fulham experiments, fully confirmed all that had been advanced in its favour. Before detailing the peculiarities of the "needle" action, let us glance a while at the history of small fire-arms.

The invention of small fire-arms is of much later date than the use of heavy ordnance. At the beginning of the sixteenth century, hand-guns, or small fire-arms, formed a very small part of the armature of even the best-provided European armies; and they differed from cannon almost only in the calibre and weight, and in being made so that they could be carried about by a single man. It was impossible to take aim at an object without the aid of a rest attached to the stock, which was planted into the ground when they were to be fired. The firing itself was performed by a lighted match, borne in the hand by the soldier, or—a great improvement—attached to the gun itself by a lever, that could be brought down upon the priming powder. The barrel was plain; and the awkward manner of handling the gun must have prevented the men so armed of doing much harm to the enemy by so unwieldy a weapon. At that age, as attested by Beckmann, and recently by the researches of Mr. Ewbank of New York, the Germans maintained that superiority in mechanical skill and ingenuity which is at present conceded to the English; and German artisans were the first successful improvers of the hand-gun, of which they, probably, were the inventors. They cut spiral grooves in the interior of the barrel, and fitted the ball lightly into it, to give the ball a spiral motion round its own axis when it was fired, and make it more independent of the resistance of the air, and of any defect in its own mass or shape. They invented, besides, the wheel-lock, thereby enabling the gun to be fired with greater ease and exactness. It is known that Benvenuto Cellini, the famous Florentine goldsmith, got a gun of this description from Germany, wherewith he made much havoc amongst the officers of Charles V., when that emperor besieged the Pope in the castle of St. Angelo. Dr. Kufahl of Berlin—of whom more hereafter—had the use of such an old German rifle. It was highly finished and engraved, and had a barrel about three feet long, but not too heavy, and made an excellent shot. The principal parts of the lock consisted of a disc of steel of about an inch in diameter, and three-sixteenths of an inch thick, notched all round the rim, and projecting from below into the pan that contained the priming powder; and of a cock or hammer, the fore part of which was armed with a blunt piece of pyrites. The gun was prepared for firing in the following manner:—First, a strong spring, which acted upon the disc, was wound up like that of a clock; then the hammer with the piece of pyrites was let down upon the disc, and kept to it by a strong flat spring; and, lastly, the pan was filled with powder. When the trigger was drawn, the disc

* Page 214, Vol. II., Practical Mechanic's Journal.

revolved in contact with the piece of pyrites, and struck fire with it. As the disc made rather more than a full revolution, the gun was not liable to missfire; but the great disadvantage of this arrangement was, that the priming had no protection to it whilst the cock was on the disc.

The next step in the course of improvement of small fire-arms, and a very decisive one, was the invention of the flint-lock. It is of French origin, and for a century and more France held the monopoly of furnishing almost every other nation with gun-flints, the material being found there in great abundance and perfection. The flint-lock, of course, did not at first present the same shape or arrangement of parts, in which it was familiar to every sportsman some twenty years ago, and to every soldier till very recently; nevertheless, it seems to have been very effective from the beginning. Its main advantage was, that it kept the priming powder under cover until the very moment of firing; and, considering the gun as a military weapon, this lock presented another most useful feature. The soldier got the priming powder into the pan of his musket, merely by putting down the cartridge; consequently, he was not obliged to bestow on the priming that particular care, which he might not always have leisure or recollection enough to give in the hurry of an engagement. It was mainly from this consideration, that some governments hesitated so long a time in introducing into their armies the English invention of the percussion lock, which in all other respects is far preferable to it.

At the time of the introduction of percussion locks and percussion priming, when the means of comparison were so near at hand, it could not fail to be observed, that besides lessening the chances of missfire, the use of percussion priming had an influence upon the quickness of the discharge, and that the powder in the barrel had, as it were, acquired an additional energy in driving off the bullet. But it does not appear that this obvious fact was taken advantage of for further improvement, but the charge of powder was lessened a little in the course of practice.

Some writers suppose that the rifling of gun-barrels was originally adopted from a mistaken notion, that a ball, by having a spiral motion given to it, would attain an additional penetrating quality, by boring into the object it was fired at. We may justly doubt the truth of this suggestion, for it is well known that the hunters and warriors of the middle ages had contrived to impart a spiral or spinning motion to arrows, for no other purpose than to guide them along their flight, and making them more independent of the varying resistance of the air. In the case of guns, the same object was very well accomplished by rifling the barrel, and causing the ball to take a firm hold of the grooves. But although the shooting quality was much improved by this means, the difficulty of ramming down a ball of somewhat larger diameter than the calibre, and the consequent loss of time in charging, were so very obvious, that it has never been thought advisable to provide a comparatively large part of a regular army with common rifles. Of course, many expedients have been tried to overcome so glaring a defect; but however different these may appear on a first view, they may be classed under two heads—viz., altering the shape of the bullet, and secondly, loading the gun at the breech.

For facilitating the loading of a rifle from the muzzle, by merely altering the shape of the bullet, there is, perhaps, no better means than that adopted by Mr. George Lovell, and introduced in the British rifle corps. His ball is encompassed by a strong bevelled zone or belt, which exactly fits into two correspondent grooves cut out of the interior of the barrel, and it is made air-tight by a greased patch. No part of the bullet being of larger diameter than the correspondent part of the bore, it need not be hammered in, but is driven down to the powder merely by pressure. Nevertheless, the strong and prominent belt guides the bullet securely along the winding grooves, and most effectually prevents the stripping. The belted ball, it is true, presents a little more surface to the air than a plain one, but with the strong charge of powder and the great weight of bullet adopted, this is of less consideration.

It is a well-established fact, that the direct resistance a body meets in moving through a fluid medium, is much greater than that caused by the friction of the fluid against the sides, or that which arises from the fluid being unable to fill up, quickly enough, the partial void formed at the hind part of the moving body. Any form, therefore, calculated to lessen the direct resistance of the air, will, to a certain extent, increase the range of the bullet. The bullet formed to the shape of a sugar loaf partakes of this advantage. It is known in France as Delvigne's, and in England as Lancaster's bullet; but very ancient specimens made of that form, and used for cannon of small calibre, are shown in the armouries of England and the continent. To facilitate the loading, Delvigne's bullet is of a little less diameter than the calibre of the gun, and the hind part of it, which is nearly cylindrical, is provided with two prominences or wings, just large enough to enter the grooves of the barrel. At the base, a cylindrical or slightly conical hole is cast in, under the supposition that the powder, in the act of exploding, would expand the lead encompassing the hole, and thus moulding it into the barrel, would prevent the elastic gas from escaping, and supersede the use of a patch. But this is not at all likely to happen. The lead of the bullet, from its softness, will yield to any impression; and as it cannot be said that the bullet fits the bore perfectly before the explosion, it must, when this takes place, be subject to the pressure of the gases from the periphery as well as from the interior of the hole, and consequently these pressures will neutralise each other. To gain his end, Mr. Delvigne has lately fitted a small iron cap to the hole, which is made somewhat conical, expecting that it would be driven farther in by the explosion; but this contrivance cannot affect the validity of the objection. Besides, a bullet, which is hollow, cannot but meet with a greater resistance from the air than a solid one of the same shape, weight, and material, for the latter may always be made of smaller diameter.

An improvement of a somewhat less problematical character was brought forward some years ago, in France, by Mr. Thouvenin. His rifle is called there Carabine à Tige, and in Germany Stielbüchse or Spitzkugelbüchse; and its use is widely spread in both countries. Thouvenin's improvements relate both to the gun and the bullet. The breech pin which closes the barrel has a cylindrical plug projecting into the barrel, of about a quarter of an inch in diameter, and of a length which is determined by the charge of powder the gun is to take. The pin or plug stands up just in the middle of the bore, forming an annular chamber, and it is of such length that the charge of powder, the gun being clean and held in an upright position, will not fill more than about two-thirds of the chamber. Consequently, when the chamber is closed at the top by the bullet, the powder will be quite loose in it, but at such a height that in any ordinary position of the gun it will cover the touch-hole. The fore part of the bullet is a cone of considerable acuteness, the hind part a cylinder, and the end is flat. The cylindrical part fills the bore as nearly as may be; and to aid the fitting, a thread of worsted, well greased, is wound around it in a groove made for its reception. The ramrod, which should be made of a rather heavy material, has one of its ends enlarged nearly to the calibre of the gun, and is hollowed out conically to correspond with the fore part of the bullet. For loading, the powder is measured in, then the bullet pressed down till it reaches the plug, and lastly a few smart strokes of the ramrod are given to make the plug enter a little into the flat end of the bullet, whereby the lead is spread out so as to enter the grooves of the barrel and effectually to fill the bore. In the operation of ramming, the enlarged part of the ramrod acts as a guide to the bullet, keeping its point in the line of the longitudinal axis of the barrel. There are usually four grooves in the barrel, and the latter are of the same breadth as the ribs.

Thouvenin's rifle, besides the ease and expedition of loading, and the pointedness of the bullet, offers a real advantage in the quickness wherewith the combustion of the powder is effected. Experiments show that a large solid lump of gunpowder is, comparatively speaking, very slow in combustion, which may be seen in a rocket; and even that a cannon, which may be quite safe in being fired with its common large-grained powder, would rarely withstand the sudden shock of quickly exploding fine rifle powder. The more interstices there are between the particles of powder, provided the grains are in actual contact, the more quick and forcible the explosion; and the powder is quite loose in the chamber of Thouvenin's gun.

It cannot be denied that this rifle does very well for sporting purposes, and in such cases generally, when it is not required to have a shot ready in the shortest time, or to fire a great many rounds in quick succession. But as a military weapon, it labours under very serious defects. Gunpowder of every description, the very best not excepted, always leaves a residuum after combustion; and this residuum encroaches upon the space of the chamber in such a manner, that after a certain number of shots have been fired, the charge of powder will completely fill the chamber, and cover the top of the plug. Then, of course, there is an end to the plug penetrating into the cylindrical part of the bullet, and the chamber wants cleaning, which, unless the barrel be taken from the stock and the breech pin unscrewed, can only be accomplished by a tedious process of scraping it from the muzzle. The Prussian rifle battalions have been armed with this kind of gun for the last three years, and consequently have had a full experience of its advantages and defects. They are now exchanging it for the *needle* rifle.

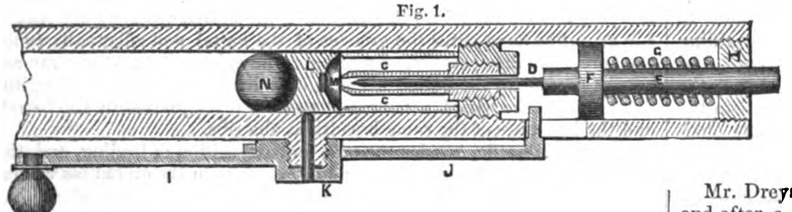
The chamber rifle (Kammerbüchse), introduced into the Austrian service by General Augustin, is one and the same gun. There is no plug in the chamber, but the bore of the latter is of somewhat less diameter than that of the barrel, thus forming an abutment, upon which the ball is rammed down, and thereby spread out laterally. We are assured by good authority that this rifle is liable to fouling even more than the plug

rifle, which may be accounted for by the round ball being less able to clean the barrel, in passing out of it, than the pointed bullet.

We mentioned loading at the breech as the second main expedient for adapting rifled guns for those services where quick loading is required. This principle has been worked upon from a very early date, and it has been carried out, from time to time, in various ways. In most of the earlier ones, the breech, or that part which was to contain the powder and ball, was raised upwards, out of contact with the barrel, in order to allow the charge to be put in, and then let down again and closed by a strong spring, or a combination of levers and catches. According to another plan, the breech was kept immoveable in the stock, and the barrel either raised up or turned sideways, to uncover the breech or loading chamber. Other inventors made the breech to resemble a common water-cock, and its turning plug, to receive the charge. In Roberts' gun, the barrel is open both ways. Near its hindmost end it has a strong trunnion forged on either side, and upon these trunnions a cap is hinged, which is to close the end of the barrel, after the charge has been put in, and for this purpose is provided with a lever of considerable length. All these contrivances might answer their end for an occasional shot, and with a small charge of powder; but as neither the joint at the back of the barrel could be made to withstand a considerable force of powder for any length of time, nor any adequate means were provided for repairing the joint quickly and effectually after it had been worn, the inventions proved utterly useless for serious purposes, and accordingly they have never been introduced as a general means of aggression or defence.

Soon after the French Revolution in 1830, the prospects of a continental war attached a particular interest to the improvement of fire-arms. It was about this time that Mr. Dreyse, the eminent percussion-cap and gun manufacturer of Sömmerda, in Prussia, invented a gun. which is called Zundnadelgewehr in Germany, because it is discharged by a smaii pin or needle being forcibly brought into contact, and thereby igniting the priming, which is lodged in the interior of the barrel, between the bullet and the powder. Though now obsolete, Mr. Dreyse's original scheme has the merit of having opened a new field for valuable improvement, and therefore it deserves a somewhat more particular description. Fig. 1 of our engravings represents the horizontal section of the hindermost part of this gun, seen from above. A, Is the barrel; its bore is enlarged

Fig. 1.



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for the last two and a half, or two and three quarter inches, for the reception of the needle mechanism. Just forward of this enlarged part, a few screw-threads for fastening the breech are tapped into the barrel. The breech, B, is formed of a piece of hard brass or gun-metal. That part of it which is in advance of the screw-threads is cylindrical, and fits closely into the barrel, whilst the part behind the screw-threads is square to admit of being taken hold of by a screw-driver. The cylindrical fore part of the breech is bored so as to form a chamber for the reception of the powder; and in the middle of this chamber, a small tube, C, is inserted for the purpose of guiding the pin or needle, D, by the movement of which, out of the tube, the explosion of the priming is to be effected. The needle is connected with the cylindrical bar, E, bearing the disc, F, which is of such a diameter as to move freely backward and forward in the enlarged part of the barrel. A spiral spring of some strength, G, is put over the needle-bar, between its disc and a plug, H, which closes the end of the barrel. This spring keeps the fore part of the needle-bar close to the end of the breech as long as the gun is not cocked, and in this state the needle protrudes about three-eighths of an inch from the mouth of the tube, C. To cock the gun, the crank, I, mounted on a screwed stud at the right side of the barrel, and lying horizontally, with its crank in a forward position, must be turned half round, whereby the flat bar, J, connected eccentrically with the crank, will act, through a slot in the side of the barrel, on the disc of the needle-bar, moving the bar backward, drawing the point of the needle into the tube, and at the same time compressing the spiral spring. At the end of this movement, a flat spring, acting from below the barrel, and connected with the trigger, will catch the lower part of the disc, thereby preventing the spiral spring from recoiling. By this movement of the crank, the pin, K, which is connected with it, and reaches through the screwed stud into the interior of the barrel, is also withdrawn, and the gun is thereby made ready for loading. The cartridge for charging the gun differs from the common one, in so far as it contains not only the powder and ball, but also the priming. A cylindrical plug, L, formed of pasteboard or paper, and of somewhat less diameter than the interior of the barrel, is hollowed at one end, so as to form a lodgment for the bullet, and at the other there is made in it a recess, into which the explosive composition, M, to be used as a priming is compressed. The plug is fastened to the ball, N, by being glued into the paper of the cartridge, whereupon the powder is put in, and the paper folded up like that of a common musket cartridge. To perform the loading, open the cartridge and run down the powder into the chamber; next, having torn away all the loose paper, put in the plug and ball, which, being of considerable less diameter than the bore of the barrel, will glide down by their own weight, until the priming plug comes to rest on the rim of the chamber. The crank now being brought into its original position, as shown in the engraving, the pin will press on the side of the priming plug, and will also keep the bullet from falling out of the barrel. The needle-bar and needle, in the meantime, are restrained from moving by the flat trigger spring; but they may be instantly released by drawing the trigger, whereupon the needle is pushed forward by the spiral spring, and will penetrate the priming, kindle it by friction, and set fire to the powder.

This invention seems to have originated from a desire to do away with the inconvenience and loss of time always to be incurred by separately handling so small an object as a common percussion-cap; and it cannot be denied that it not only fully attained this end, but that it is altogether a much more rational plan to have the priming in the interior of the barrel, in immediate contact with the powder, and to ignite it by the almost infallible means of friction, than to explode it by a blow at a distance, and to send the fire to the powder through a narrow and crooked channel. But this is nearly all that could be said in recommendation of the scheme. To obtain quick loading and firing, the great principle of using a rifled barrel, and a bullet exactly moulded into it, was sacrificed; and no gun whatever could be made to shoot true with a ball of so small a diameter as to descend, by its own weight merely, from the muzzle to the breech. The gun, besides, could not be brought to half-cock after it had been loaded, and must, on that account, be considered as highly deficient in point of safety. It was therefore of little moment, with respect to the applicability of the needle gun, that Mr. Moser altered the mechanism of its lock, in so far as to obviate the necessity of opening the cartridge, and tearing away part of its paper before loading.

Mr. Dreyse, however, did not despair of finally attaining his object; and after a laborious and expensive course of experiments, in which he was supported in the most liberal manner by the Prussian government, he at last brought forward a really serviceable military needle gun, which, having a rifled barrel, and loading at the breech, is equally famous for quick firing, a great range, and an accurate shot. For a considerable time the construction of these guns, as well as the cartridges for charging them, were kept a profound secret, and are even now fully understood by a few persons only, although they have been introduced into the Prussian army to the amount of about 50,000 pieces, and are used there with the greatest satisfaction. It is unnecessary here to give a description of the Prussian needle gun, as its construction will be evident from that of Mr. Sears. Suffice it to say, that the inventor got the first idea of such a gun from Mr. Moser's experiments, and, of course, worked it out quite independently from Mr. Dreyse.

The principal points to be attended to, in constructing a really serviceable and efficient gun, may be stated in the following terms:—

1. The gun should make a very exact shot, therefore the barrel must be rifled, and the bullet moulded and fitted into it in the most accurate manner; and to prevent loss of time, such fitting should be attained, not by any external means, as, for example, by a ramrod, but by the explosive force of the charge itself.

2. With a certain quantity of powder for a charge, the bullet should acquire the greatest possible velocity. Therefore, not only the bullet should be of such a shape as to meet with the least resistance from the air, but all the explosive force of the charge, including the priming as well as the powder, should be made available for the propulsion of it; nor should there be any sensible escape of the gases at the sides of the bullet.

3. In handling, the gun should be perfectly safe. It ought to be impossible, either to introduce a stronger charge than it is calculated to

bear, or to load before the moving parts of the lock are brought into such a position as to be unable to act on the priming, or to put in a new charge before the last one was fired or withdrawn. For the same reason, it should be very easy to *return* the loaded gun from full-cock to half-cock.

4. The gun should not easily foul; and as exploded gunpowder always leaves a residuum behind, there should be a space in the interior of the gun, where the residuous matter might accumulate without impairing its efficiency.

5. The gun ought to be of such a construction, that it could be charged, with the utmost ease and expedition, in any position of the body—in standing, sitting, lying down on the ground, on horseback, or even in the rigging of a ship. Consequently, there should be no occasion for a ramrod; the powder, priming, and bullet altogether to form one body, and this to be introduced into the barrel at once, by means of a few easy movements of the right hand.

6. Ready means of cleaning and repairing should also be provided for; and all repairs likely to occur should be very cheap, and of easy execution by competent hands.

7. The gun should be as light as is compatible with safety and efficiency, and its weight should be properly distributed.

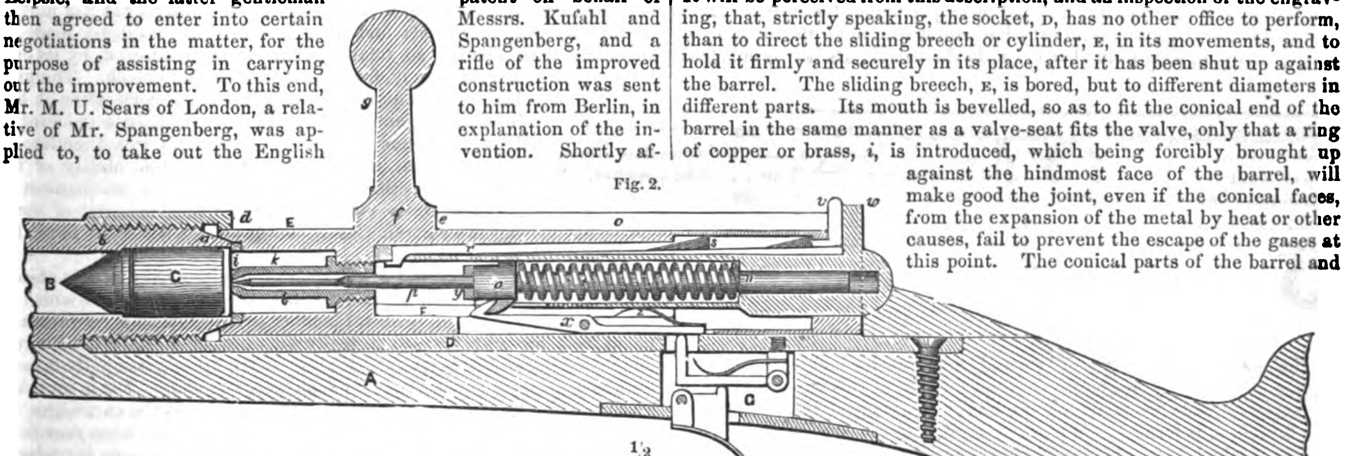
8. There should not be any danger or difficulty in making the cartridges.

A gun fulfilling all these requirements would, we suppose, come up very nearly to perfection, and therefore we may fairly use them as a standard for criticising the invention now before us.

We have before incidentally mentioned the new Prussian needle gun, as being popularly known under the name of "Sears' Needle Gun," and before going into its details, it may be as well to state to whom we are in reality indebted for the invention; our information being furnished partly by the Prussian inventor, Dr. L. Kufahl of Berlin, and partly by matter-of-fact documentary evidence.

In the summer of 1849, Dr. L. Kufahl, an engineer in Berlin, having had his invention by him for some years, communicated his intention of patenting it in England, to a Mr. E. G. Spangenberg, a merchant of Leipsic, and the latter gentleman then agreed to enter into certain negotiations in the matter, for the purpose of assisting in carrying out the improvement. To this end, Mr. M. U. Sears of London, a relative of Mr. Spangenberg, was applied to, to take out the English patent on behalf of Messrs. Kufahl and Spangenberg, and a rifle of the improved construction was sent to him from Berlin, in explanation of the invention. Shortly afterwards, Mr. Lovell, H.M. inspector of small arms at the Tower, visited Dr. Kufahl at Berlin, and had one or two of the new pieces shown to him, with an intimation that the invention was being patented.

Fig. 2.



Early in October, in the same year, Mr. Sears visited Leipsic, where it was finally arranged with the inventor, that the English patent should be obtained in Mr. Sears' name, as a communication from abroad, with a provision as to the pecuniary interest of the several parties therein. The result of this was, that on the 11th of January, 1850, Mr. Sears obtained a patent for an "improved construction of guns and cannons, and manufacture of cartridges for the loading or charging thereof—(a communication)," and immediately thereafter took measures to introduce the gun to the notice of the Board of Ordnance. At his request, Dr. Kufahl came over to England in February, and on the 26th of that month, the first of the series of trials which have since been so much noised abroad by the newspaper press, took place at Woolwich, before Lord Clarence Paget, and the select committee of examination. Every newspaper reader knows the history of the brilliant successes achieved in the many subsequent trials both by the Government officials, and at Lord Ranelagh's residence at Fulham. The ball, 1½ ounces in weight, with the expenditure of only 2½ drams—half the usual service-charge—of powder, being fired at the range of 400 yards, with a result hitherto unapproached by any fire-arm in existence. On one occasion, to test the absolute range of the needle musket, a ball was fired across the Thames, near Gravesend, a distance of more than a mile.

It is right that so important an invention should be attributed to its legitimate owner, and it is with considerable pleasure that we have made the pages of this *Journal* the means of first publishing the fact of Dr. Kufahl's undoubted claim to all the merit which the "needle gun" deserves.

Fig. 2 of our engravings is a longitudinal section of the new rifled needle gun adapted to military service. The gun is represented as being at half-cock, and loaded. A, Is the stock; B, the barrel, turned to a cone at *a*, and provided with screwthreads at *b*. Internally this part of the barrel is enlarged in its bore, so as to form a convenient lodgment for the cartridge, C. The barrel is screwed into a strong tube or socket, D, which is bored very truly, and provided at the top with a slot, *c*, extending from behind to the point, *e*, and about four-tenths of an inch broad; but between the points, *d* and *e*, so much of the socket is cut away, that an oblong opening for the introduction of the cartridge may be gained. E, Is a cylinder, turned very carefully to the internal diameter of the socket, in which it is to slide with the least possible friction. This cylinder, which forms the breech of the gun, contains, or has attached to it, all the other moving parts of the lock, except the trigger. At the top, the cylinder, E, is furnished with a prismatical prominence or ledge, *f*, and a handle, *g*, by which means it can be moved backward or forward in the socket, D, or may be locked up against the conical part, *a*, of the barrel, B. The longitudinal movement is performed by holding the handle, *g*, in an upright position, and drawing the ledge, *f*, backward in the slot, *c*, whereby the loading hole situated between *d* and *e* will be uncovered. On the contrary, to shut the loading hole, and to bring the conical mouthpiece of the sliding cylinder, E, into contact with the end of the barrel, the handle must be thrust forward as far as possible, and then turned downward to the right side of the gun. In this position, which is represented by the engraving, the hind part of the ledge, *f*, interlocks with a slightly inclined plane, which forms the boundary of the loading hole, and whose outline is indicated by the dotted line below *e*. It will be perceived from this description, and an inspection of the engraving, that, strictly speaking, the socket, D, has no other office to perform, than to direct the sliding breech or cylinder, E, in its movements, and to hold it firmly and securely in its place, after it has been shut up against the barrel. The sliding breech, E, is bored, but to different diameters in different parts. Its mouth is bevelled, so as to fit the conical end of the barrel in the same manner as a valve-seat fits the valve, only that a ring of copper or brass, *i*, is introduced, which being forcibly brought up against the hindmost face of the barrel, will make good the joint, even if the conical faces, from the expansion of the metal by heat or other causes, fail to prevent the escape of the gases at this point. The conical parts of the barrel and the sliding breech, as well as the ring, should be fitted to each other with the utmost accuracy. Just behind the ring, *i*, there is a space, *k*, in the sliding breech, called the back chamber. Its use is to receive the residuum of the powder, and also to contain some air, which, by its elasticity, eases the recoil of the gun, and being strongly heated, and consequently expanded, by the explosion, will give an additional impulse to the bullet. In the interior of the back chamber, *k*, there stands up, from a diaphragm in the sliding breech, the needle guide, *l*, a small tube whose office is sufficiently expressed by its name. It is squared on the outside in order to be taken hold of by a little key, when it is to be screwed into the sliding breech. That part of the sliding breech which is behind the diaphragm contains another tube, F, closed behind, but open in front, and called the spring barrel, and in it there are lodged the main spiral spring and the needle-bar, *n*, with the nut, *o*, and the needle, *p*. The under side of the spring barrel, F, is in part filed flat, and it is provided, besides, with a slot, wherein the two lower teeth of the nut, *o*, travel backward or forward, as the spiral spring is

compressed or released. The greater part of the upper side is likewise flat, by which means, and some hollowing out of the upper part of the interior of the sliding breech, E, space is gained for lodging a stout spring, *r*, whose office it is to retain the spring barrel, F, in those different positions which it may be required to take. The spring, *r*, is flat below and rounded above, and is held to the fore part of the spring barrel by a hook and a pin, as seen in the engraving; further back, towards the end of the lock, it is provided with two catches, *s*, that work in a recess chambered out in the interior of the sliding breech; and lastly, its hindmost part is turned upwards at *v*, so as to project above the socket, D. This part of the spring, *r*, is protected from injury by a prominence, *w*, of the spring barrel. The projection, *v*, may be pressed down by the thumb of the right hand, and then the spring barrel may be drawn out, independently of the sliding breech, as far as a small screw and a slot, *t*, will permit. A similar slot and screw is used for preventing the sliding breech being drawn out further from the socket than is necessary to open the loading hole; or any other convenient means may be employed for this purpose. The spiral mainspring should be of such a strength as to carry about sixteen pounds weight, and it should be a little longer than the space included between the narrow part of the spring barrel, F, and the nut, *o*, when the latter is not held back by the detent lever, *x*, but is in contact, by the little copper or brass ring, *y*, with the diaphragm of the sliding breech, E. In other words, the spring should be of such a length, that it cannot be put into its chamber without using some force; and it will be confined there, when the spring barrel is drawn back, by the hook at the fore part of the flat spring, *r*, engaging with the uppermost tooth of the nut, *o*. The detent lever, *x*, oscillates on a small pin or axle in a recess or slot of the sliding breech, and consequently does partake of its movements. In order to engage this lever with either of the lower teeth of the nut, *o*, there is a small spring, *z*, riveted to it. The trigger mechanism, G, does not appear to require any particular explanation; its manner of action will be easily understood from the engraving.

The gun being uncocked, and the sliding breech locked to the socket by the ledge, *f*, of the handle, *g*, being in contact with the shoulder, *e*, all the parts will be in the position shown in the drawing, except those contained in the spring barrel, for the mainspring will be unbent, the nut, *o*, by means of the ring, *y*, in contact with the diaphragm of the sliding breech, and the thinner part of the needle, *p*, will stand out in advance of the needle guide, *l*. Now, grasp the gun with the left hand near that point where the barrel and socket join, and hold it in a horizontal position at the right side of the body, just as if a copper cap was to be put on the nipple of a common musket or fowling-piece.

1. Press down the spring, *r*, by laying the thumb of the right hand upon the projection, *v*, and pull out the spring barrel, F, as far as possible. Both the catches, *s s*, will then be seen outside of the sliding breech, E.

2. Unlock the sliding breech by a smart stroke of the right hand against the knob of the handle, *g*, and draw it back as far as possible through the slot, *c*, in the socket, D, whereby the loading hole between *d* and *e* will be opened.

3. Take the cartridge between the thumb and the two fore-fingers, put in the cartridge and push it well home.

4. Shut the loading hole by pushing the handle, *g*, forward, and turning it over with a moderate force to the right side.

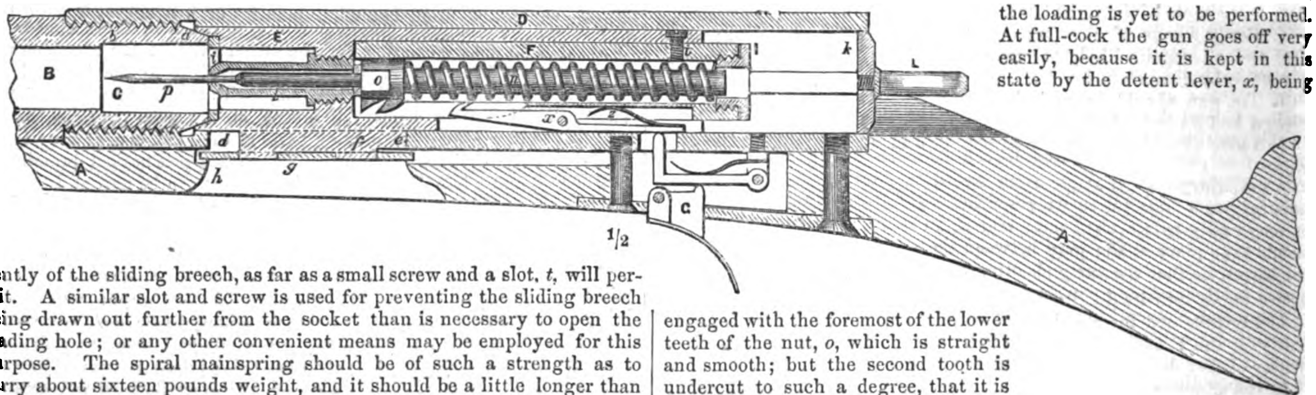
5. Push the spring barrel, F, quite home into the sliding breech.

6. Raise the gun to the shoulder, take due aim, and fire.

When firing is not wanted immediately:—Instead of fully pushing in the spring barrel, push it in so far only, till the first of the catches, *s*, engages in the recess in the sliding breech, then draw the trigger, and finally push the spring barrel quite home. The gun, by this movement, is brought to half-cock, and will not go off in this state.

To load the gun without a view to fire immediately:—Pull out the spring barrel to such an extent only, that the foremost catch, *s*, takes the position which the hindmost has in the engraving, and perform the movements 2 to 5. To bring the gun from half-cock to full-cock:—Pull back the spring barrel as far as possible, so as to uncover both the catches, *s*, and then push it fully home.

Fig. 3.



Each of the movements, from 1 to 5 inclusive, may be easily gone through in a second of time, the sixth only requiring somewhat more, because firing at random is quite at variance with the character and legitimate use of this gun. Nor is there any shadow of danger in any of the movements; for the handle cannot be unlocked, and consequently the loading hole cannot be opened, before the spring barrel, and with it the needle, be pulled back; and the spring barrel and needle cannot be pushed fully home, so that the latter might touch the priming, before the sliding breech is locked to the socket. In other words, the gun cannot be charged, while the mechanism that causes the explosion is able to act, and it cannot be fired as long as any one of the movements connected with the loading is yet to be performed. At full-cock the gun goes off very easily, because it is kept in this state by the detent lever, *x*, being engaged with the foremost of the lower teeth of the nut, *o*, which is straight and smooth; but the second tooth is undercut to such a degree, that it is impossible to disengage it in opposition to the combined force of the main-spring and the spring, *z*, without tearing away the hook of the detent lever.

Fig. 3 is a representation of the same gun, neither loaded nor cocked, and the mechanism somewhat differently arranged. A, The stock; B, the barrel, ending in a cone at *a*, and screwed at *b* into the socket or tube, D. The socket is provided with a longitudinal rectangular slot, *c*, and a loading hole, but the latter is not on the upper but on the lower side, between *d* and *e*, and the former could not be shown in the engraving, because it is situated at the lower part of the right-hand side of the socket. The gun, of course, must be charged from below, instead of from above; and to favour the introduction of the cartridge at this place, there is a recess, marked *h*, cut out of the stock. The construction of the sliding breech, *e*, is, in appearance, nearly the same as in fig. 2, but it need not be so long, and is much easier manufactured. There are no recesses to be made in its interior for receiving a spring, armed with catches like *r* in fig. 2, and it may even be made in one piece with the spring barrel, F, which is represented as a separate part only for the sake of keeping the analogy with fig. 2. The prismatical projection or ledge, *f*, to be used for locking up the sliding breech to the inclined plane or shoulder of the socket, situated behind *e*, is on the under side of E, and to this ledge a curved plate, *g*, is screwed or riveted, which going up through a recess in the stock to the right side of the socket, takes the figure of an oblong ring there, and is to be used as a handle for moving the sliding breech. The spring barrel, F, may be made, as we said before, in one piece with E, as it is not required to be moved out of it for the sake of cocking the gun; its hindmost part is closed by a screw, F, which confines the main spiral spring. The screw is perforated in the middle in order to allow the needle-bar, *n*, to pass, when the latter is drawn back in the act of cocking. When the spring barrel, F, is not made in one piece with the sliding breech, it must be kept to the latter by the small screw, *t*. The two lower teeth of the nut, *o*, for engaging the hook of the detent lever, *x*, are of the same construction as in fig. 2, and so is the whole of the lower part of the spring barrel. There is no tooth to the upper part of *o*, but there is one at each side of it, by means of which the nut and needle-bar may be drawn back, and the spiral mainspring compressed, when the gun is to be brought to half or full cock. To perform these movements, a distinct cocking frame is made use of. It consists of a ring, L, at the outside of the socket, a washer, *k*, and two flat bars, which are provided with hooks at their fore end, and engage with the teeth at the sides of the nut, *o*. To admit these bars between the sliding breech, E, and the spring barrel, F, the sides of the latter are made flat throughout, and slotted at the fore part. The trigger mechanism is the same as in fig. 2.

Having grasped the gun with the left hand, as directed before,—

1. Put the tip of the fore-finger of the right hand into the ring, L, and draw back the needle-bar, *n*, and nut, *o*, to half or full cock.

2. Unlock the sliding breech by a smart stroke of the right hand against the underside of the ring handle, and draw it back as far as possible.

3. Take the cartridge between the thumb and the two fore-fingers, and raising the point of the bullet somewhat above its hindmost part, introduce it through the loading hole.

4. Shut the loading hole, and push in the cocking frame.

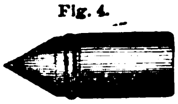
5. Raise the gun to the shoulder, take aim, and fire.

At the first view, it would seem that it was more difficult, and consequently did take more time, to introduce the cartridge from below than from above, but in practice this is not found to be the case. The recess, *h*, in the stock, performs the office of guiding the cartridge and fingers so well, that the loading hole cannot be missed, and there is not the slightest occasion for looking at it. In loading from below, therefore, the eyes may be kept more steadily upon the object to be fired at, which is of some consequence, when this object is an enemy ready to fire in his turn. There are some other advantages obtained from placing the loading hole at the lower rather than at the upper side of the socket. In this position, with the additional covering effected by the handle-plate, *g*, the fore part of the sliding breech is much better protected from external injury—for example, from sword strokes in a démêlée; bits of unburnt paper from the cartridges either will fall out of their own accord, or may easily be knocked out; and if, in course of time, any leakage should take place at the joint between the sliding breech and the end of the barrel, neither the party shooting nor his neighbours can be incommoded by the escaping powder smoke.

The manner of cocking adopted in this gun, gives it a small advantage in point of time over the construction of fig. 2; but, on the other hand, it is not of so easy performance, and requires more practice to do it with expedition and certainty.

The cartridge, consisting of the charge of powder, the priming, and the bullet, contained in a cylindrical paper case, is represented in fig. 4, and the bullet in fig. 5. The latter is pointed in front, its hind part is cylindrical, and of such a diameter as just to fill the bore of the gun. There are three rings formed on the cylindrical part, projecting to such a degree as to touch, everywhere, the interior surface of the spiral grooves cut in the barrel. By this construction the bullet, in its passage through the barrel, not only prevents any loss of the elastic gas evolved from the powder, but acquires, in the most perfect manner, that spiral or spinning motion round its own axis, which is essential for directing and guiding it in its flight; and the pointed shape given to the fore part is that which experience has shown to offer the least resistance to the air.

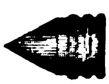
Fig. 4.



1/2.

The number of the grooves in the barrel, whether four, six, or eight, seems to be indifferent, but four will do as well as more; care should be taken, however, to lay out in the grooves fully one-half of the interior surface of the barrel, and neither less nor more, otherwise the bullet would be liable to strip. The bullets may be cast in the common way, but it is a better plan to make them by machinery.

Fig. 5.



1/2.

The priming of these cartridges consist of a composition of fulminate of mercury, enclosed on all sides in a small flat capsule of thin sheet copper. To keep the capsule just in the middle of the longitudinal axis of the cartridge, so as to be certain of being hit by the point of the needle, it is to be fastened by a few light strokes with a wooden mallet in a hole punched out in the middle of a washer of pasteboard, about one-fifteenth of an inch in thickness, and of equal diameter with the cylindrical part of the bullet.

The powder to be used is the common rifle powder, and the one hundred and twentieth part of a pound is sufficient for a charge for a military rifle. It has been supposed, from the long range of these guns, that the powder used was of a particular kind, and its strength increased by admixture of some other explosive substance; but this is not at all the case.

To manufacture the cartridges:—Sheets of paper, thin, but of a firm texture, are cut into small squares, and, by means of an iron cylinder for a mould and glue, form them into tubes, one and a half inches in length, and of such a diameter as just to admit the bullet into the interior. Cut out washers of the same diameter, and glue them into one end of the tubes, so as to form bottoms of a single paper thickness for them. Into the paper cases so formed, first put in the charge of powder, next the pasteboard washer containing the priming, and lastly, the bullet. Fasten the case to the bullet, by tying a cotton thread round the paper between the first and second ring; cut away all the paper projecting in advance of the first ring of the bullet, and smear all the outside of the cartridge with warm tallow, or a mixture of tallow and hog's lard. Cartridges so made may be kept for months in damp places without becoming liable to missfire, and may be handled and carried about quite free from danger.

Let us now try whether or not the patent needle gun would be able to fulfil all these conditions which are stated above, as being the requirements of an efficient and serviceable fire-arm.

1 and 2. According to experience, the gun makes a very exact and most effectual shot. The bullet being made of the exact proportions set forth, follows the spiral grooves without being liable to strip; it is moulded into the barrel singly by the explosive force of the powder itself, and preventing by its size all escape of gas at its sides, goes up to the target with peculiar force and velocity. Moreover, the charge of powder being set fire to at its foremost part, not a grain of it can escape being burnt; whereas it is well known, that with the common manner of lighting the powder from behind, a quantity of it is almost unavoidably thrown out unburnt at the muzzle.

3. All the conditions insisted in this paragraph are fully answered in the description of fig. 2, and even the modification, fig. 3, is, in point of safety, greatly preferable to common guns.

4. There is a space in the back chamber, *k*, provided expressly for the reception of the residuum of the powder, and the barrel is kept clean by the bullet itself, which, by touching every part of its interior surface in passing, removes all the foulness.

5. The quickness and ease of loading afforded in these guns is quite unparalleled, and too well known to require insisting upon.

6. In all three modifications, the spring barrel with its appendages may be taken out and cleaned by removing a single small screw, and the sliding breech too, in fig. 2. The parts of the lock might even be kept together by a single catch, and by this means might be made removeable in one second of time; but then the gun would not stand so well every kind of rough handling, which it must be required to bear in military service. As to wear and tear, no other parts of the lock, if well made in the first instance, are subject to it, but the tightening ring, *i*, and perhaps the main spiral spring, and both can be removed instantly and replaced by new ones, at a charge of a fraction of a penny per piece.

7. The gun, British musket size, does not weigh more than ten pounds and a quarter, and the weight is distributed properly.

8. It will appear, from the description given, that there is neither danger nor difficulty in manufacturing the cartridges.

It is not at all necessary for us to point out to intelligent military officers, all the particular advantages to be gained by the introduction of the needle gun into the service. The experience acquired in the Prussian army speaks better to the point, than volumes of theoretical deductions. The only objection of some weight that has been raised is, that the men could not be kept from firing too quickly, and throwing away the ammunition. But this may be got over, and is really surmounted, by good training; and it would be too great a folly to intrust a soldier with such a first-rate weapon, without fully teaching him how to use it in the very best manner for the ends of aggression or defence. In the Prussian service, the soldiers armed with needle guns carry 120 cartridges, 40 or 60 in the knapsack, and the rest in two cartridge boxes, fastened, at either side of the body, to the sword belt. Firing in an unbroken line, the men do not stand farther asunder than if they were armed with common muskets, but when they act as tirailleurs, they keep interstices of from eight to ten or more paces. In this service they are directed to take advantage of every object in their way that might be used as a covering, never to fire without taking due aim, and when they lie down, to plant their small swords into the ground, and use the cross bar of the handle as a rest for the gun. All the exercises with the gun are simplified to the utmost, and every care is taken to make the soldier a good marksman, fully able to realise all the advantages which are offered by the capabilities of the gun.

Hitherto we have considered the patent needle gun only as a military weapon; but it is evident that it is equally well adapted for sporting rifles and fowling-pieces, where it will be found to combine economy with convenience and safety. A sporting rifle of this construction need not be of any greater weight than a common one, and with a charge of powder equal to the hundred and eightieth part of a pound, and a bullet averaging from an eighteenth to a nineteenth of a pound in weight, it has an effectual range of 350 to 400 yards. Fowling-pieces, of course, ought not to be rifled; and in the cartridge, either the washer containing the priming should be made somewhat stronger, or an additional one introduced between it and the charge of small shot, to prevent the needle pushing the priming forward instead of piercing and igniting it. To lessen the weight still more, and to improve upon the appearance, the barrel and socket of these guns may be made in one piece, it being quite immaterial whether there are any means provided for disuniting them

or not; only the prime cost of the gun would be increased a little by the latter construction.

CLOSE OF THE GREAT EXHIBITION.

Saturday, the 11th of October, 1851, will be a memorable day. The Exhibition of Industry of all Nations was closed. *Ichabod* is written upon the chiefest of those nations. The great glory of the age is departed. The beautiful shell is indeed left upon the shore, but the more wondrous thing which it sheltered is become as though it had never been. No more shall we, in wending our way to view that thing comprising legions of things, see the great glass dome sparkling in the sun like a fair promise which we know will be fulfilled. All the treasures are removed to the strongholds of the nations. The crystal fountain is destined to add lustre to a more lustrous clime; and the fountains of eau de Cologne and aqua d'oro have ceased to regale the sense. "The veiled vestal" is gone for ever to sit before the shrine of admiration or neglect; and "The Children in the Wood" may have gone to lie with Ishmael in the desert. The Amazon, with Godfrey of Bouillon, and our first Richard of the lion heart, are all strayed no one knows where. The Mountain of Light (which some say was the identical mountain which brought forth the mouse) and the Sea of Light—the great emeralds and sapphires and rubies, might as well never have been extracted from their matrices, for what the world will henceforth care about them. The Bavarian lion, and all other lions, are marching back in dignity to their distant lairs. The Dodo no longer greets us with its resuscitated uncouth form. The Austrian and American and Prussian eagles, in company with the jewelled gleed, have flown away for ever, bearing on their wings to every land some tokens of significance. The comical creatures from Würtemberg are themselves transported, after transporting the million. Reineke Fuchs, with all his merry cunning, is left to resume his place among his biped fellows. To shrine his soul, no dignitary of the church appears in his pontifical coat of many colours. Magical creatures of all kinds are quietly returning to their own enchanted groves. The ark is distributing its denizens among the realms of the earth, whence they came flocking for the glorious 1st of May, 1851; not as saved from the anger of a threatening heaven, but encouraged by all holy influences. The click-click of the envelope-making machine is sounding in another home. The great hydrostatic press, steam-hammer, and other idle things, which had left their working powers to the imagination alone, are now off to the business of their lives. Even Rosa Matilda's handiwork hath gone into gloom. The great hands of the electric dial no longer point to the anxiously-awaited opening hour; the din of the great bells and gongs and tom-toms at night, no longer promise new enjoyment on the morrow. All busy Liverpool and Manchester and London have returned to work. The little English lads—the ancient English matron—who travelled hundreds of miles on foot to see the splendours of the Great Show, are by this time tired of recounting their many adventures. The Asiatic, the African, the American, have all returned home —the latter with more feathers in their caps than appeared in Mr. Catlin's costumes. The sight-seer's occupation is gone. Three things more, and all will be finished. The medals have to be distributed into every region. The unique glass-case is to be destroyed or supported. The Royal Commissioners have to spend their mint of money. It will be time to consider these as they may pass before us. But as, for the last of many, many not unprofitable visits, we, on the last day, with the national anthem still echoing through us, and in the midst of the grateful cheers of all people, cast a last long look on the magnificent nave, and the still more magnificent transept, something approaching to a sigh of regret escaped us, that we could not ourselves assure ourselves of the permanence of the structure; and the voice of autumn, not as yet toned down to its yearly melancholy, whispered among the trees, we thought, some sentiment of kindred sorrow.

Let us now turn to a topic more pleasing than the illustrious example of evanescent grandeur noticed above. Has the Great Exhibition fulfilled its promise? But what was its promise? Perhaps the most thoughtlessly enthusiastic will now ingeniously answer this question by denying that it promised anything; it not being convenient to define in words what it was expected to do, as well as what it has done, or what it is doing, or will do. As to what it was expected to do—how various may have been the ideas of different persons! By some, of warm imagination, and habituated to certain forms of thought, nothing less than a kind of millennium was at hand; when all the nations of the earth would be united, heart and soul, not in seeking their own, but every one another's good; when all the races of man would meet on common ground of mutual recognition of worth. Happily this has not entirely failed. For the Exhibition has doubtless done something towards bringing people together, and enforcing them, by the subtlest moral means, to hold out the hand of fellowship. The more civilized would do this as a kind of patronage to the rude barbarian, who, in his turn, prompted equally with feelings of admiration and gratitude, cannot avoid striving to excel where the display of former effort showed but mediocrity, or even bare performance of simple labour. One thing visible, here and there, in elaborate or the most ordinary detail, in the Great Museum which has now departed from us, is the attempt (often realised in scientific results or instruments) to increase human power. Among the Indian figures we noticed one, where a farm labourer was lending his own weight to the efficiency of a harrow, in performing its allotted task. It struck us, as we were looking at this figure, that it was eminently symbolical of what the man most advanced in civilization merely does—but in another way. For what are even the most wonderful instruments and engines for, but to increase the power of man over those elements, which in his rude state have universally been considered to be leagued against him, and which, as his power has increased, show them only more and more subject to his just dominion? Again, the Exhibition has been particularly fertile in showing common things surrounded by such new associations, as to compel us to look a little more at our old friends, and to see, in their old faces, characters of good-will towards us, which carelessness had obscured. How many have been the times, when, we doubt not, in common with the most of our readers, we have participated in the pleasure which new things commonly inspire, when all at once it has occurred to us that the thing itself, and by itself, is as old as *our* Adam! The very complexion, literally speaking, of the crystal dome, both externally and internally (but we allude particularly to the latter) was an instance of this. There were Mr. Owen Jones's three primitive colours, blended with that scientific art which a long life of study had elaborated—what, except their orderly combination in this mightiest building, should ever have made us turn and reflect how very singular and exquisite is each distinct colour in itself! It were, however, endless and useless to follow in the course which this thought suggests, where so many analogous instances will recur to the reader, on recalling what he may have viewed, with more than a casual glance, in the storehouse of the nations. Never did those magic words of Henry Brougham come home to us with greater power, than when, as we passed and repassed the various courts of the palace, we *saw* how "the schoolmaster is abroad," and is teaching, with these more ostensible things, other matters which are little dreamt of in any of our philosophies. How often, in the midst of our dullness, we start to find ourselves more knowing than we thought ourselves, not having considered it worth while, apparently, to notice the road over which all the time we have been travelling! Wonder how such and such a thing has been brought about—is made to stand in place of that working-tool of experiment, which seems, to our imagination, to have been lost in the early time, whether of ourselves or of our ancestors! Hence it is that the Exhibition has been, not a romance, but a book to study. It has been desecrated to very ignoble purpose, when it has been made a mere play-place to while away an otherwise tedious and wearisome hour. Hence, to see what the Exhibition still is doing, we must penetrate into many secret places, and sacred too—sacred as is silent thought. For in such spots is it now alone exerting its vital power, and may be elaborating greater wonders yet, which shall cast into obscurity all crystal palaces and such like. It must have time to work its way, as it required time to be read when the volume lay open before us; and we are thankful to be of those who can trace, however faintly, some glorious features in the comparatively insignificant indications of the present. The Exhibition has shown, existing in the human mass, an inconceivable amount of potentiality; a very little effort of the imagination could manage to lift itself up above the noblest examples of skill and beauty, and new worlds of industry open themselves to view at every pass. It would be interesting to speculate upon what our posterity will think of this great doing, which we now regard but as a germ of future excellence, when it shall not have a shade of oral testimony to refer to, and its tale will be told in printed record alone. Possibly may they estimate many of the items of the long catalogue more highly than we ourselves have done. "New ideas attached to old words," have, no doubt, ever been a bane to truth. Is it Gibbon or Hume who wisely bids us beware what significance we give to the so-called cities of antiquity, when a large modern village might put them to the blush? Even so, how many things become interesting by *making* them of interest! How many things were there in the Exhibition which were at first heedlessly passed over, when, observing an "explanation" placard upon them, we turned again to admire; and how very few things there were which appeared, after a little reflection, as ridiculous as the gimcrack army ornaments, which found companionship with raiments of the priesthood, and the tawdry embroidery of masonic childishness!

GAR MILL.

ROBINSONS & RUSSELL,
Engineers,
Millwall, London.

Fig. 1.

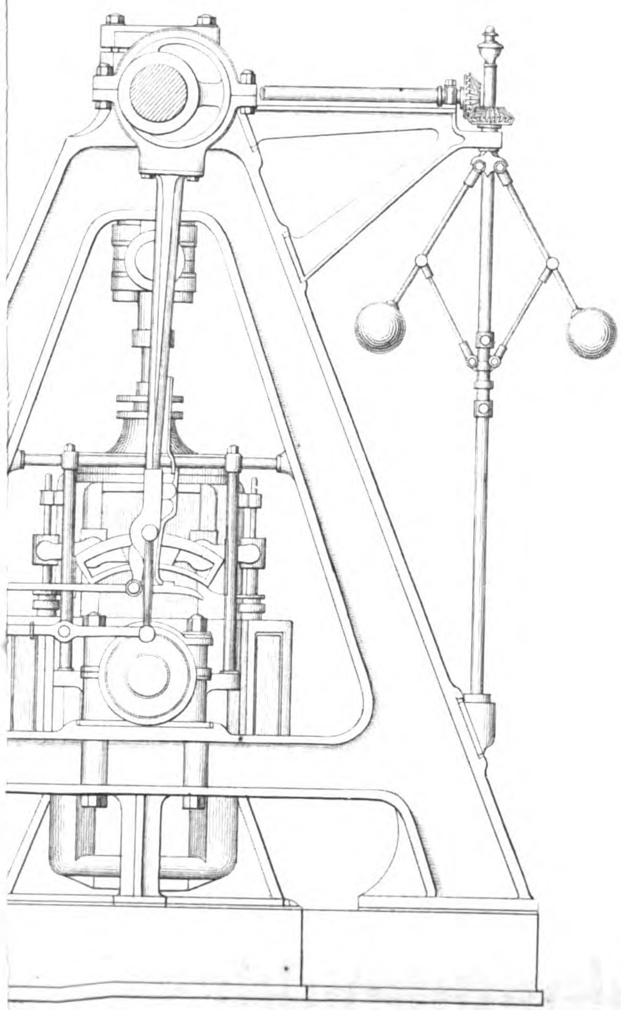
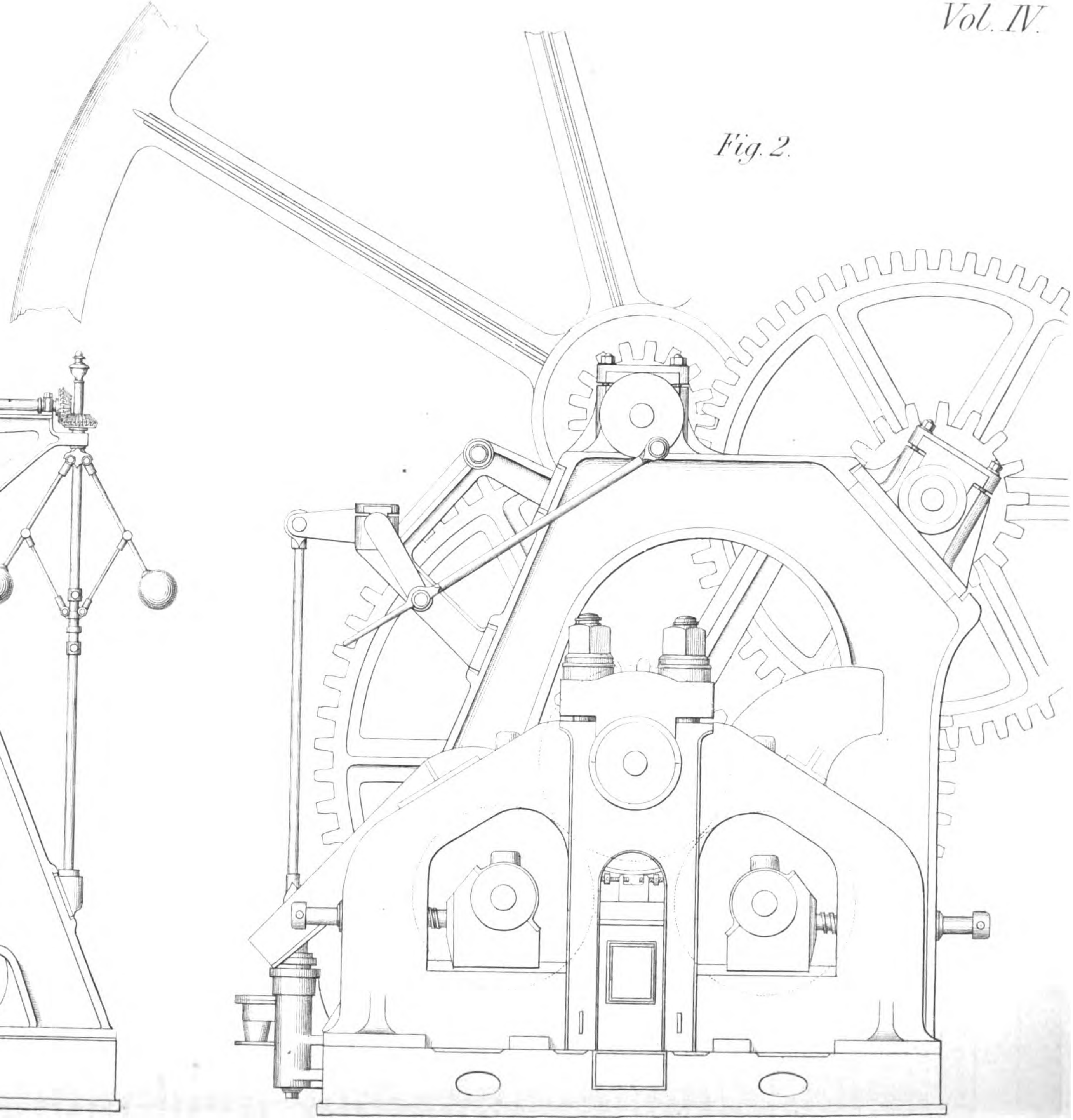


Fig. 2.



2 0 0 1 2 3 4 5 10 15 Feet

All history does not furnish one example of any such gathering together of the people, as the last week of the Exhibition showed. From all points of the compass—at every rate of speed, from tottering infirmity to the activity of the rail, they came. Young men and maidens, old men and children, came on and on, and still on, in greater and greater numbers. On they came in broughams, gigs, coaches, omnibuses, cabs, carts of every imaginable make and appearance. On they came, whole families—almost whole towns—the individual visits of many of those days numbering more than the inhabitants of our larger provincial cities. We have occasionally left when the building seemed full; but, far as the eye could reach, there were the thousands facing us, hurrying up—many with babies in their arms—to the great feast. With all these pleasing sights, one looked upon one's imagined last visit as to something dreadful. And when we had paid it, the question occurred to us—What was the greatest sight of all? The products of the world's industry, or the millions who flocked to see it? Which were the days when we most enjoyed ourselves—on the aristocratic Friday or Saturday, or the plebeian shilling day? There was ever that about the former which, notwithstanding the readier means we possessed of gratifying what æsthetic power was our own, never could warm it into such enjoyable life as we experienced among working men.

One of the most brilliant days of the season aided to relieve, in some measure, the moral gloom of the occasion. As the day dwindled away, and hour after hour told that the closing moments were at hand, the interest seemed singularly drawn towards the people themselves, each of whom appeared to be gazing around upon all the others as upon parting friends. Four o'clock came—half-past four—five! and then Herr Sommer and the organs roared forth the national anthem in musical thunder, and the noisy sound of British cheering proclaimed to the wide world that the revel was ended.

"The West End," ordinarily dull at this season of the year, is now wrapt in perfect gloom; for, although the magnificent glass dome is still left for the wandering restless eye to take in a while, the noblest royalty has gone from it, the standards of the people are no longer hoisted upon it, waving, as they did, a music without sound, which made glad the general heart. All the stirring life of first-jubilee faces, that thronged the neighbourhood by millions, now lies—dead. Many are the voids now found only by the iterations of the simple words, "I wish we had the Exhibition again"—that time, when

"The happy homes of England"

seemed about us and around us, and we read, in the smiling faces of old and young—in the "Look there, father!" of the little child, and the surprised joy of the thoughtful brow, all that man may do for man!

Far sounding is a nation's gratitude to a conqueror returning from a battle-field, and substantial is the nation's praise; yet he was but bidden to go forth for hire and win the fight, and he has but done his bidding. Peaceful triumphs appear, by some of our rulers, to be entitled to a different ovation, or rather to no ovation at all. We are a curious people. When the success of the Exhibition was doubtful, on the opening day we sent forth the prime hierarchs of the established creed, in the midst of the congregation, to pray for success, and the people, as with one heart, joined therein. The Lord of all peace heard the desire, and has bountifully answered the prayer. But thanksgiving has been muttered only in the still small voice of the individual breast, and more deeply, probably, is it poured forth there proportionate to its cosmopolitan absence. Such a termination, after such a beginning, is to be deplored, and the memories which must constantly arise will as constantly rebuke us for this remissness.

We commenced this paper with a long array of things that were and are not. We have adverted to one great unpardonable oversight, and there is another not to be disregarded. We mean the total absence of all grateful thought for the memories of those illustrious men to whose labours we are indebted for the display. We believe we speak correctly when we say, that no statue or bust of either Francis Bacon, or Newton, or Watt, was visible in any part of the building. It is deeply to be regretted that something of this was not thought of; for comparatively few are able to console themselves with mentally appropriating to these illustrious men, that sentiment which has so long supplied the place of a cenotaph to the architect of St. Paul's Cathedral—"*Si monumentum requiris circumspice.*"

MESSRS. ROBINSONS AND RUSSELL'S EXHIBITION SUGAR-MILL.

(*Illustrated by Plate* 84.)

In plate 84, we have presented two views of this ponderous piece of machinery, which has attracted so many lookers-on in the Exhibition. The makers have termed it a "patent steam sugar-cane mill, in which the engine, gearing, and mill are all combined upon the same base plate, to render it portable and independent of the expense of masonry." Fig. 1 is a front view of the oscillating steam-engine which actuates the mill, together with the supporting standard for the engine cylinder and main overhead shaft. Fig. 2 is an end view of the rollers and framing, with the driving gearing, at right angles to fig. 1.

We shall, next month, give, in a second plate, a side view of the whole machine.

MECHANIC'S LIBRARY.

Agriculture of Lancashire, Notes on the, 8vo, 5s., sewed. J. Binns.
Arithmetic, Bonnycastle's, 18th edition, 12mo, 3s. 6d. S. Maynard.
Astronomy, Every-Day, 12mo, 5s., cloth. B. Gazewell.
Chemical Technology, Lib. Illus. Standard Scientific Works, (Vol. 10), Vol. 3, 8vo, 22s., cloth. Dr. F. Knapp.
Chemist, The Young, 12mo, 1s., sewed. H. H. Paul.
Chemistry, Principles of, Translated by Peirce, "Bohn's Scientific Library," post 8vo, 5s., cloth. Stockhardt.
Dyer's Instructor, 12mo, reduced to 15s., cloth. D. Smith.
Geometry, On Descriptive, plates, 2s. J. F. Heather.
Great Exhibition, 1851, Recollections of the; 24 Views of the Interior of the Crystal Palace, £3. 3s. tinted, £8. 8s. coloured.
Hydraulic Tables, royal 8vo, 10s. 6d., cloth. E. Ryde.
Industrial Arts of the Nineteenth Century, a Series of Illustrations, Part I., folio, 7s. 6d., wrapper. M. D. Wyatt.
Industry, Magic of, "Books for the Rail," new edition, foolscap 8vo, 2s., sewed.
Marine Boilers of the United States, 8vo, 12s., cloth. B. H. Bartol.
Naval Gunnery, Treatise on, 3rd edition, 8vo, 21s., cloth. Sir H. Douglas.
Physiology, Manual of, 2nd edition, 12mo, 2s. 6d. W. B. Carpenter.
Polarized Light, Familiar Introduction to, 2nd edition, 3s. Woodward.
Practical Dyer's Guide, 8vo, reduced to £2. 2s., cloth. D. Smith.
Practical Mathematics, Part 3, Logarithms and Plane Trigonometry, 12mo, 2s. 6d., cloth. J. Elliot.
Problems, Solutions of the Cambridge, 1848-51, 8vo, 15s. 6d., cloth. Ferrers & Jackson.
Prognostic Astronomer, 12mo, 5s., boards. W. J. Simmonite.
Workshops, The World in its, 2nd division, 12mo, 1s., sewed. J. Ward.
Workshops, The World in its, complete, 12mo, 2s. 6d., cloth. J. Ward.

RECENT PATENTS.

ELECTRIC TELEGRAPHS.

George Little, *London.—Enrolled Sept.* 14, 1851.

Mr. Little's improvements consist:—1st. Of the suspension of the indicators, or such parts of electric telegraphs as may be desirable, by means of magnetic attraction, whereby the telegraph is rendered less liable to the deranging influence of lightning. 2d. The supporting of the same details by means of floats of blown glass, or other buoyant material contained in glass tubes.

Fig 1.

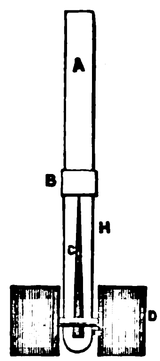
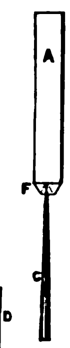
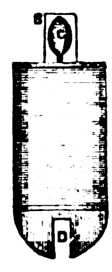


Fig. 2



Our engraving, fig. 1, is an elevation of a magnetic apparatus so arranged. A permanent magnet, A, is fixed in a holding socket, B, above a glass tube, H, containing alcohol, and answering as the containing reservoir of the needle, C, suspended from its upper point by the attractive power of the permanent magnet. Coils of wire, D, are secured to the glass by a cross piece, E; and an electrical current being passed through these coils, the lower, or pendulous, end of the needle is made to pass to the right or left, as may be desired, thereby producing any number of conventional signals. In such a contrivance, the sides of the tube act as stops for the needle's vibrating indicators, whilst the alcohol serves as a continuous lubricant—preventing the sticking of the needle during any of its movements. Fig. 2 is a side view of a coil of wire, with the indicating needle, C, suspended from the bottom conical recess, F, in the magnet. Fig. 3 illustrates the second, or float, arrangement. A coil of wire has a glass tube, B, passed through its centre, this tube being filled with spirits of wine, carrying upon its surface a float, C, from which a magnet is suspended. When the electrical current is passed through the coils, the magnet is acted upon, so as to rise and fall in its tube, carrying with it the float, out of sight, or nearly so, and thus producing a series of conventional signals. One or more of such instruments may be secured to the dial-plate of a telegraphic instrument, by a screw passed into the slot, D. Both these arrangements are very important improvements upon the needle action.

Fig. 3.



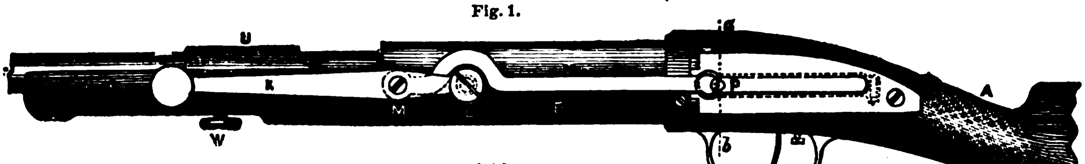
REGISTERED DESIGNS.

GERMAN AIR-GUN.

Registered for BERNARD RIEGE, ESQ., *Finsbury Square, London.*

Mr. Riege's design is an improvement upon that class of air-guns, in

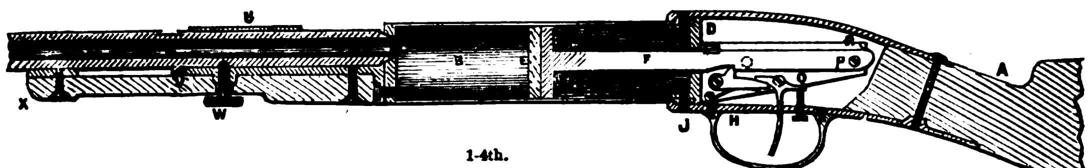
Fig. 1.



1-4th.

which, as in Mr. Shaw's India-Rubber Air-Gun,* the air is compressed for each individual shot, instead of being provided with a magazine of compressed air for a series of shots. This compression is accomplished by the recoil of a powerful helix of flat steel, contained in the breech of

Fig. 2.



1-4th.

the piece, and acting on a piston in a short air-cylinder placed between the lock and the inner end of the barrel.

Fig. 1 is an external longitudinal elevation of the lock mechanism of the gun. Fig. 2 is a longitudinal section of the same parts. Fig. 3 is a transverse section through the dotted line at A B; and fig. 4 is a similar section across the inner end of the barrel. The stock, A, is fitted with a bored air-cylinder, B, the front end of which has an eccentric conical hole, C, whilst its opposite end is closed by a lid, D. E, Is the air-piston fast on the rod, F, over which is placed the spring, G, abutting between the piston and the cover, D. The cylinder is attached to the stock by the guard-plate, H, and the screws, J. What may be termed the air-loading action, is effected by the lever-handle, K, turning on a fixed centre, L, on the side of the cylinder, and having jointed to it at M the link, N, passing backwards to the end of the piston-rod. By turning the lever-handle half round, to bring it to a horizontal position in the opposite direction, the hook, O, fast to the end of the link, N, and working through a side slot in the stock, presses against the stud, P, in the piston-rod, and thus draws back the piston to the position represented in fig. 2, compressing the spring between the piston and its abutting end cover, D, of the cylinder. So long as the handle lies over towards the butt end of the gun it cannot go off, but when the handle is turned over again towards the muzzle, as in fig. 1, the resistance of the link, N, then being removed, it may be discharged. The lock is mounted on the plate, Q, in one piece with the cover, D, of the cylinder, and a small projection, R, is fitted to the end of the plate to keep the piston-rod steady when the gun is cocked. A plate, S, covers up the slot when the latter is not in use for the traverse of the hook, O. The barrel, T, of the piece is held firmly to the air-cylinder by the tube, U, through which it is passed, sliding accurately within it. In charging, the barrel is pushed forward through the tube, U, as far as the stud-pin, V, which works in a slot in the continuation of the tube. The charge, either a ball or a small dart, is then introduced by the opening for that purpose in the top of the tube; which done, the barrel is replaced, and secured by the screw, W. The piece of wood, X, virtually forms a continuation of the stock, being fastened to the lower part of the tube, U, by screws. The trigger mechanism, as delineated in fig. 2, is extremely simple, the discharging action being effected by the trigger depressing the small hook-lever which holds back the piston, by catching into a notch in the lower side of it. The reaction of the compressed spring then brings the piston sharply forward in its cylinder, effecting a high degree of condensation of the air therein, which drives out the charge from the end, C, of the barrel.

Fig. 3.

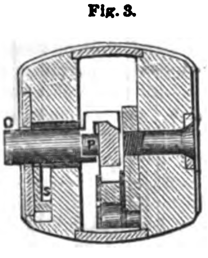


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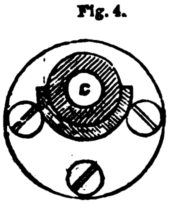
Fig. 4.



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* See Practical Mechanic's Journal, Vol. III., page 30.

DIRECTION TABLET.

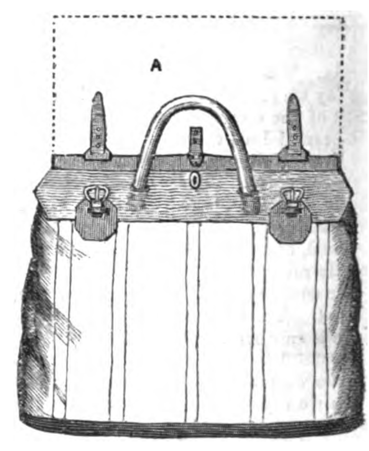
Registered for MESSRS. COX & WILSON, *Oldbury, Oxfordshire.*

This little contrivance is intended to facilitate the operations, and add to the convenience of the traveller, in furnishing him with the means of quickly attaching a satisfactorily legible address to his luggage. The "Direction Tablet," or "Travelling fitted Label," then, consists of a narrow brass frame, with bevelled edges, with back screws and nuts, like an ordinary door-plate, for attachment to the article to be directed, and slotted or grooved out longitudinally for the reception of a series of 14 cubes of boxwood, each having a letter on five of its sides, whilst the sixth is blank. One end of the slot, or containing groove, is loose, and is arranged to screw tight, and lock up, to hold the cubes like types in a galley. When the tablet is to be made up for use, the cubes are removed, and placed out, with their blank sides downwards. When this is done, the letters so presented form an arrangement, by which any word is easily spelled, by finding the required letter on the list, or table, accompanying the tablet, and selecting the cube, the top letter of which corresponds with the letter at the top of the column. Then, of the cubes that remain, half are placed with the blank side uppermost in the slide, then those spelling the name, and lastly, the remaining blanks, when the loose end is secured in its place, to hold the address immoveable.

LIFE-PRESERVING TRAVELLING BAG.

Registered for MR. S. WILSON, *Merchant, Glasgow.*

Mr. Wilson's "Life-Preserving Travelling Bag," of which our annexed engraving is a side elevation, has been constructed for the purpose of securing a life-preserving power of flotation in ordinary travelling bags, with very slight additional modification or expense. Externally, the bag differs in no respect from the common traveller's companion, the body, A, being made of india-rubber cloth, or other air and water-tight material. Round the mouth of this bag, is an open fold of the same material as the bag itself, which, when the bag is not in use, will fold down inside, so as to take up no perceptible additional space. When the bag is in use, and filled in the ordinary manner, with clothes, the additional fold, B—represented by the dotted lines, as turned out of the bag—is drawn together, thus closing up the entrance, and making the entire bag air-tight. The fold then being depressed to the top of the bag, the latter may be closed by the side band or flap, C, being strapped over the mouth. It is a simple and effective modification.



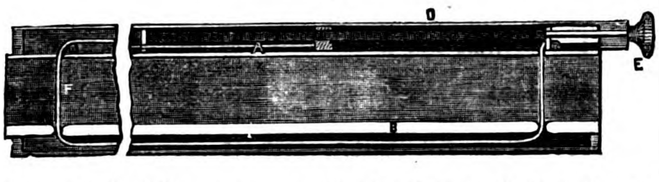
PAPER CLAMP.

Registered for JULIUS ROBERTS, ESQ., R.M.A., *Portsmouth.*

Lieutenant Roberts' design is intended for the securing of loose papers, or as a temporary binding for pamphlets. Fig. 1 is a longitudinal sec-

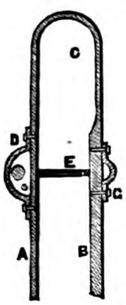
tion through the clamp or binding action; and fig. 2 is a transverse section of the flexible back and clamp movement, as broken away from the containing boards or covers. The two covers, A B, forming sides for

Fig. 1.



the receptacle of the papers, are united, by their longitudinal edges, by a flexible back, C, like a portfolio. To the outside of one of the covers is riveted a semi-cylindrical metal tube, D, for the reception of a long screw, fitted with a milled head, E. This screw turns in an external collar close to its milled head, whilst its opposite end is carried by a suitable bearing in the interior of the tube, D, where is also a traversing nut fitting to the screw. To this nut is attached a stout silk or gut cord, F, passing from it along the tube, D, and round a fixed pin at the opposite end, thence through holes in both covers, returning along the outside of the opposite cover through a guide tube, G, being again passed through similar holes in the contrary ends of the covers, and finally attached to the collar of the screw. In attaching papers in one body by this clamp, all that is necessary is, to lay them between the covers, and turn the screw, when the traverse of the nut tightens up the cord, F, and draws the covers together.

Fig. 2.



SPUR.

Registered for J. Roberts, Esq., R.M.A., *Portsmouth.*

This second invention of Lieut. Roberts gives to the spur a capability of being readily and easily attached to, and detached from, the boot of the wearer, without the necessity of introducing a socket into the boot, or otherwise interfering with its construction. Fig. 1 is a side view of the new spur as fixed for use—drawn full size. Fig. 2 is a corresponding longitudinal section; and fig. 3 is a plan of the same. The frame, or clip, A, which embraces the heel, is provided with two small internal pins, B, which enter the front of the heel; and the stem, C, which carries the rowel, is screwed through the rounded back of the frame, and presses against the heel, through the intervention of the small plate, D. This plate is joint-riveted on to the extreme end of the stem, after the latter has been passed through the frame, A, and its upper edge being turned over, it enters between the heel and upper leather as a steadying support. The spur is attached by unscrewing the stem, C, until the plate, D, touches the inside of the frame, when the latter is slipped upon the heel. The stem, C, is then screwed up, its end turning freely in the plate, D, until this plate is pressed firmly against the back of the heel, with its upper angular edge entered between the heel and upper leather. By this pressure, the pins, B, are obviously fixed into the front part of the heel, whilst the frame is firmly bound up by the screw pressure, the turning of the stem, C, being prevented by the set nut, E.

Fig. 1.

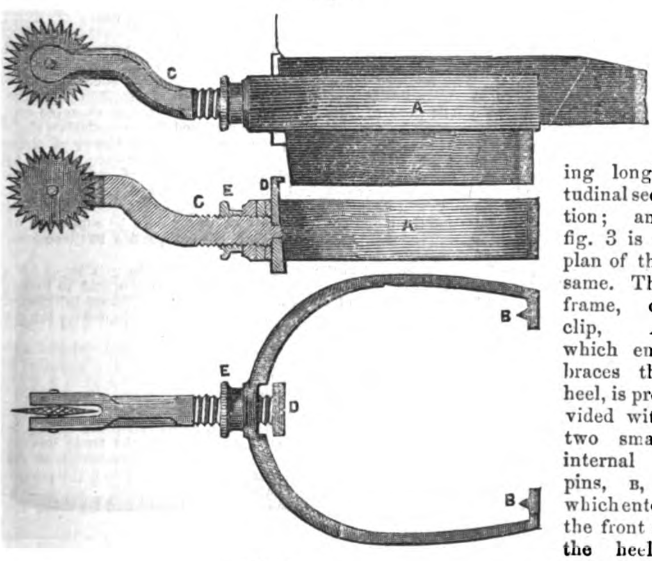


Fig. 3.

STOKER'S VENTILATOR.

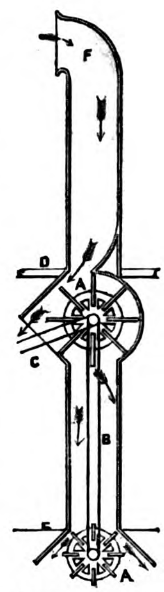
Registered for H. Studdy, Esq., *Waddeton Court, Torquay.*

Whoever has felt the overpowering heat usually existing in the engine-rooms of steamers, will appreciate Mr. Studdy's humane exertions for the stoker's benefit. The "Stoker's Ventilator" is intended to ameliorate the condition of the enginemen and stokers, by introducing pure and cool air into the contracted space allotted for the performance of the severe labour of marine-engine management. This is effected by means of fans placed in suitable funnels, and set in motion either by the machinery or other means.

Our engraving, fig. 1, is a vertical section of the ventilator, wherein A A are the two fans, connected so as to revolve together by the endless band, B, and driven by the band, C, from the engine. The line of the upper deck is at D, and the lower grating at E. The arrows point out the direction of the cold air currents taken in by the upper curved funnel entrance, F, standing above deck. The mouths of the funnels are to be set in opposition to each other, so that a general circulation may be secured in the engine-room and the centre of the vessel, more particularly in steamers running before the wind or during bad weather, when the engine-rooms are covered in. Fig. 2 is a plan of the ventilating funnel, showing one of the fans *in situ.*

In addition to the arrangement which we have figured, the inventor proposes to lead off cool air from the funnel to any distant spot, by means of cheap canvas pipes.

Fig. 1.



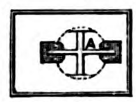


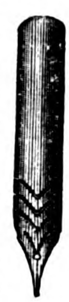
Fig. 2.

PERISTALTIC PEN.

Registered for Messrs. M. Myers & Son, *Birmingham.*

The Birmingham steel pen trade is one of the most marvellous examples of the rapidity of growth, and gigantic commercial importance, of the manufacture of an intrinsically trivial article, under the effects of modern mechanical invention. In the year 1820, the earliest manufactured gross of "three-slit" steel pens was disposed of wholesale for £7. 4s. In 1830 the price fell to 8s. a gross, and two years later to 6s. Better pens are now produced for 6d. a gross. Birmingham is said to send out 1,000 millions of pens per annum; and one single factory there makes 40,000 gross, or 6,760,000, per week, nearly three hundred millions a year. The highest price at the present day is about 5s. a gross—this sum being charged for pens of the best elasticity and finish. The cheapest are made with a profit at 2d. a gross, wholesale price. About 2,000 persons are employed in the manufacture.

Messrs. Myers' pen, of which the annexed figure is an external view, presents the nearest approach to the natural elasticity of the quill that we have yet met with. The rigidity of the ordinary pen is here removed by a series of curved slits in the barrel portion of the pen, immediately above the termination of the central writing slit. This portion of the barrel is bent pretty flat on its inner side, the two edges being brought nearly into contact, and the elasticating slits are carried round the greater portion of the barrel, to give greater ease of action. In writing with this pen, we at once feel that a new power of elasticity has been given to the steel, but we have still to complain of the standard defect of the point catching the paper, and the imperfect fluid current from the barrel to the writing point. It is undeniable that the steel pen effects a vast economy of time, in obviating the necessity for the constant construction and repair under the old quill system; but it has to pass through many gradations of improvement, before it can be said to rival the quill in freedom and comfort in writing.



METALLIC RESERVOIR PEN.

Registered for MR. J. JACKSON, *Birmingham.*

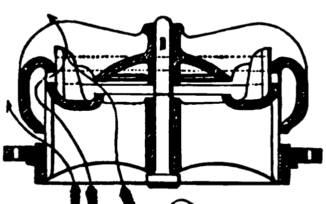
This is an invention of somewhat older date than that of Messrs. Myers, and it is the pen to which we have referred* in our description of Mr. Thomson's "Modification of the Reservoir for Gold Pens." The example—with which we are now writing—is of gold, tipped with a harder material at the writing points. The engraving represents a view of the pen on the inner or reservoir side. A small flap is cut out of the barrel at A, and bent down inside, towards the nibs, with a small rounded cup-like end. This flap being bent parallel, and pretty close to the inside of the barrel, forms a capillary reservoir for the reception of the ink. This pen writes with considerable smoothness, but Mr. Thomson's reservoir is an improvement upon it, in so far as the retention of a good supply of ink is concerned.

TREBLE-BEAT HYDRAULIC VALVES AND SEATS.

Registered for MESSRS. CARNELL & HOSKING, *Perran Foundry, Cornwall.*

Our engravings furnish an example of one form of these valves, which are modified applications of the principle involved in the "Valve applicable for Large Pumps," figured in our last number as Mr. Hosking's contribution to the Exhibition. Fig. 1 is a vertical section of one arrangement of pump-valve, and fig. 2 is a corresponding plan of the valve-cover. The effect sought for in these valves, is the making the outer beats as nearly as possible of one size, whilst the water is caused to act against the under side of the central plate, to elevate the valve when in action, thus giving a third beat and a third fluid discharge. By this means, not only is the lift reduced, but the noisy concussion of the common lift-valve is entirely prevented, whilst the wear and tear is very sensibly reduced. In addition to the plan which we have engraved, Messrs. Carnell & Hosking also show slightly different modifications as applied to the lift-bucket and discharge-valve of the air-pump of a condensing steam-engine. The figures afford their own explanation.

Fig. 1.



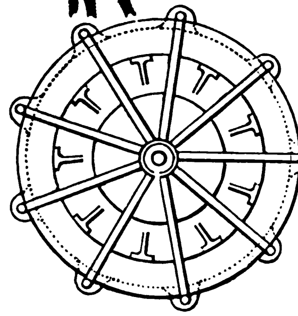


Fig. 2.

ELASTIC COACH WHEEL.

Registered for MR. T. SHILTON, *Baddesley, Ensor, Atherstone.*

This is a modification of the old form of curved spoke wheel, which

Fig. 1.

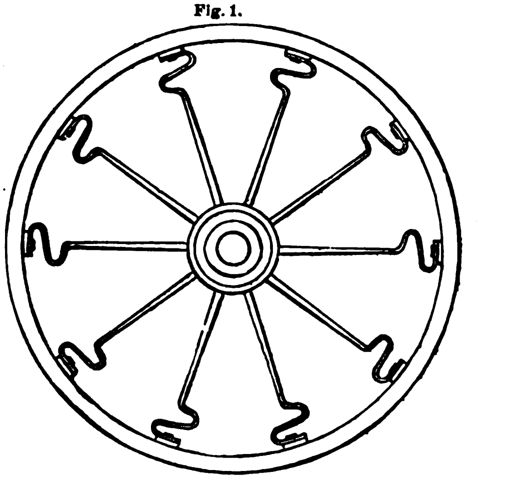
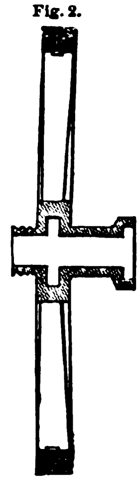


Fig. 2.



Mr. Shilton proposes to employ in various mechanical combinations, as well as simply for the running wheels of vehicles. Fig. 1 is a side elevation of the elastic wheel, and fig. 2 is a transverse vertical section. The spokes are of thin flat steel, attached at the inner ends by being screwed into a hollow nave bush, whilst their opposite ends are bent to a serpentine form—the last bend being secured by a set screw to the inside of the wheel rim. It is this curvature which gives the easy elasticity to the spokes, involving ease to the horses, and diminished draught in ascending hills.

In the practical carrying out of the silent or india-rubber tube tyred wheels, the tube or external elastic coating is very soon cut through—owing, in a great measure, to the extreme rigidity of the straight spokes—a working defect which Mr. Shilton expects to remove by the substitution of an elastic medium in the spokes themselves. He also intends to make the wheel fulfil all the conditions of separate springs; and instead of building up the rims with felloes, encircled by a hoop, he constructs this part with a mere iron hoop, one-fourth thicker than that ordinarily used over the felloes.

* See page 141, *ante.*

REVIEWS OF NEW BOOKS.

ON THE AMENDMENT OF THE LAW AND PRACTICE OF LETTERS PATENT FOR INVENTIONS. By Thomas Webster, Esq. Pp. 42. London: Chapman and Hall. 1851.

Much having been said by persons who ought to know better, as to the inexpediency of granting patent privileges at all, we shall transfer to our columns what Mr. Webster has to say on the side of common sense:—

"This question may be viewed in two aspects. 1st. Natural justice. 2d. Public policy.

"1st. As to the natural justice of such privileges—the justice of conceding exclusive privileges in respect of that upon which years of intellectual exertion may have been spent, must be conceded; but inasmuch as the elements which are combined are common property, others ought not to be excluded from availing themselves of the same combination, provided exclusive possession has been afforded sufficient to insure a reasonable remuneration for the time and labour expended in the production. The originator of the idea or invention having the control over his own idea or secret, has exclusive possession and complete disposition of whatever he may have produced. If, then, he parts with the exclusive possession of anything which may be a source of pleasure or profit to others, it is but reasonable that some return should be made for the advantages so conferred; and this can only be done by a concession of some exclusive rights to the inventor.

"2d. As to the public policy of such privileges. But public policy is consistent with natural justice. Without some return being insured for intellectual labour, a strong incentive to its exercise would be checked. The public are deeply interested in affording adequate encouragement for productions in literature, music, and the fine arts, in the arts and manufactures, and in whatever may tend to the refinement, civilisation, or innocent recreations of the people, or add to their conveniences, or increase the capital of the country, and extend its trade and manufactures.

"The policy of conceding to authors of useful inventions in the arts and manufactures exclusive privileges for a limited time, has been recognised by almost every civilised nation. It must be borne in mind that the benefit to the public results from the introduction of the invention; now this can rarely be effected without the expenditure of capital at a time when the success of the invention is altogether speculative, and the risk of a total loss considerable. The analogy occasionally suggested between such exclusive rights and monopolies so odious to the law, rests on an entire misconception. By the grant of monopolies, the public were restrained or interfered with in the exercise and enjoyment of what they possessed before—no consideration passed for the exclusive right or enjoyment from which the public were debarred; whereas the whole theory of these exclusive privileges assumes that something new is given to the public—acquisition by the public of something not already in their possession, and the power of practising the invention after the limited time shall have expired, form the consideration for the grant. The true theory of these grants will be understood by regarding them in the nature of a contract between the public and the patentee; any contract must in law be supported on some mutual consideration, and the rights and interests of the two parties to these contracts must be regulated accordingly.

"But the public are directly interested in the subsistence of exclusive privileges for a term sufficient to bring the invention to the greatest degree of perfection, and to insure its adoption and general introduction; this having been effected, the public are interested in the extinguishment of the exclusive privilege, which ought to be continued no longer than may be necessary for the due reward of the inventor.

"The rapidity with which new branches of trade and manufactures are developed and come to perfection in this country, is mainly due to the confidence with which capital is applied to inventions protected by patent, in full reliance upon its return within a very short period by reason of that protection. In many instances, a very large outlay must be incurred in preliminary experiments, before the secret of the commercial success of the invention is discovered or the trade established; capital so expended could never be restored but for the protection afforded by letters patent, inasmuch as the trade having been established, others could practise the invention free from the incumbrance of the original expenditure and manufactures, and sell at prices which must drive the person so encumbered from the market. In cases of this nature there is no prior possession of the market, or good-will of the particular trade; time would not be allowed for this; the rival would step in so soon as any demand had been created.

"It must be borne in mind, that, in a large number of cases, invention without the command of considerable capital to force the invention on the public is of no value; hence it follows that three parties have to be considered—namely, the inventor, the capitalist, and the public. It has been said with great truth, that a Boulton was essential to making a Watt; and the experience of the extension cases at the privy council proves most conclusively, that no invention involving a material departure from existing practice, can be brought into use without being forced upon the public—an operation requiring the expenditure of a great amount of labour and money. The rate of progress will, as a general rule, be found to be slower, and the expenditure greater, in proportion to the importance of the invention. Such expenditure may be regarded in the light of capital employed in ascertaining the success or failure of the invention commercially; if the invention fail, the money is irrecoverably gone; if the invention succeeds, it can only be recovered by the higher rate of profit which may be realised during the limited period of the subsistence of the exclusive privileges.

"The object and operation of protected or exclusive rights is to insure disclosure, and obviate the evils of secret manufacture; by these means each successive invention be-

comes an addition to the public stock of knowledge, available for further improvement, and for general adoption at the expiration of the patent."

Although we differ from Mr. Webster in several points, we quite agree with him in the following observations :—

"It is the duty of the state to keep two objects in view :—1. To foster inventions whereby human labour may be abridged, and mechanical agencies substituted, and capital, whether in time, money, or materials, saved, and the necessaries, comforts, and conveniences of life rendered as accessible or as widely diffused as possible. 2. To check as much as possible wasteful expenditure or useless inventions, and the creation of exclusive privileges in respect of such inventions. That system will best attain these objects which, by removing all unnecessary impediments, and reducing the risks to which inventors are now subject, shall render persons of skill, devoting themselves to improvement in the various departments of the arts and manufactures, less likely to incur loss by, and more secure of some profitable return for, their exertions."

The Law of Patents, and Registration of Invention and Design in Manufacture; with Statutes, Forms, and Rules. By Thomas Turner, Esq., Barrister-at-Law. London: John Crockford. 1851. Pp. 193.

Civilization is relative. The American Indian, without arts or arms, may well be looked down upon by the New Zealand savage, who, although much further off from European manners, is nevertheless highly cultured, and therefore, immediately, more highly capable of further culture. Some stimulus or other undoubtedly keeps up the lives of both; but whatever the specific stimulus may be, it is acknowledged that it must have a different form from that which induces to general progress. As it is with nations with reference to difference of status, so is it with a nation with reference to difference of times. What is that which imparts such interest, as we look back upon the youth and childhood of our empire? It is not alone the puny effort to break through some obstacle to progress, to be observed in that expression of the people's will which gave rise to the statute against monopolies, that makes us pleased; but it is the knowledge that that statute was the first to fix, without any wavering, a right which about that time may be said to have been born—the right which an inventor has to the fruits of his silent up-hill toil. Not, indeed, that the statute in terms gave him any protection; but by making void, as it did, all monopolies, it drew attention to that species of monopoly which natural instinct suggested should be the price paid to the inventor by the public for his precedent labours. Very gradually has this thought been expanding to the present time. It cannot, indeed, be considered otherwise than natural that it should. All the industry of the world is entitled to reward; or, to speak more correctly, there is a tariff price payable for it. It may be to be paid sooner or later; but it nevertheless must be paid, or injustice will be done. This, we think, is the true and only foundation of patent law; but in the vortex of high civilization, and in the quick succession of inventions, it has not claimed due consideration either by disputants, judges, or legislators. The consequences are what we meet with daily—the verbal abuse of this portion of the law of the realm, not by one class of persons only, but by all classes whose attention has been any way attracted to the subject. It is, therefore, with proportionate welcome that we greet any one in an attempt made "to advance the theory of a subject of jurisprudence, which presents some very peculiar and some rather subtle features."

Mr. Turner, the author of a treatise on "Copyright in Design," and "Counsel to Inventors" (both of which have been reviewed in our columns), comes forward with this his avowed object, well prepared, and the work now before us will extend his previous claims to thanks. The book is systematically divided into chapters and sections, a novel feature in the author's productions, but which is essential to the utility he appears to seek to attain to. And the several chapters and sections embody very succinctly the principal learning, legal and scientific, on the several subjects of patents and copyright in design; with an additional chapter on trade marks. All the statutes bearing in any way on the subject are inserted in an appendix, with the rules of practice laid down by the Attorney-General, the Privy Council, and the Registrar of Designs. A goodly array of cited cases appears, with instructions, and forms of procedure and tables of fees, adding to the usefulness of the volume.

The work is written in Mr. Turner's familiar style; almost too much devoid of technicality. In some places, indeed, it descends to the quaint and obscure, and even careless. Sentences like the following often occur:—"Such discoveries as the Overland route, and the mode of finding the longitude, though instances of applied science, cannot conveniently be worked into patents," p. 19. "Again, the national defences may be concerned, as in the *inferiority* of a screw to a paddle-wheel; the former being, from its position, as much out of, as the other is in, ha m's way," p. 50. "The scientific *parts* of the evidence *resembles*," &c. p. 60. "As to the transfer of the right copyright is personally, see the Literary Act," p. 102. "A difficult point in copyright is, how far the public may avail themselves of a prior work as material for reproduction (see the literary cases as to abridgments, &c.)," p. 108. We would rather not have had to notice the omission of all reference to the recent statute, enabling parties interested to be witnesses in an action. The fees at the Great Seal Patent Office are stated to be £48. 7s. 6d., whereas they are 18s. 6d. more; and the follower-stamps on specifications and disclaimers are stated to be £1, instead of 10s. stamps. There are several other small inaccuracies in Mr. Turner's statements as to the fees and practice in obtaining patents—portions of the book which he will do well to amend in a future edition. These, however, are slight blunders, compared with the general utility of the work.

We had marked several passages for quotation, but the following must suffice to afford our readers an opportunity "to taste and try before they buy." The author is speaking as to the essential feature of novelty in an invention about to be patented.

"Want of novelty is, perhaps, the most frequently fatal defect to which a patent is subject; it is a stubborn fact, while the specification, the other point of assault, admits of being favoured and explained. It affects primarily invention generally, and it also affects the extent of its limit. Is it new at all? and how far is it new? Assuming the existence of an invention, an art, or substance, different and superior to its known predecessor, then was (at the period of the patent) the inventor not only the sole possessor of the patent, but the first possessor? It is obvious that this question is closely related to that of the nature of an invention (see last chapter); the subject-matter, in one case, being viewed absolutely, and in the other, relatively, to what existed before it."

"At the outset, it may be distinguished from preceding inventions, on which it improves, defines, or modifies, or which it employs as elements for combination; it may have an originality of its own, though dependent for its practical existence on the principle of others. A steam-engine may be the main stem; a peculiar cylinder, though a mode of working the main idea, has its own essence and principle, and may be carried out by other satellite inventions, a particular kind of stuffing-box, for instance. * * * The whole question of novelty is of a highly circumstantial nature, and depends on the combined effect of the facts."

On the whole, we can fairly congratulate Mr. Turner upon the result of his labours. He appears to bring to the task the requisite amount of legal knowledge, combined with an intimate acquaintance with art and science. We should be glad to find Mr. Turner applying his powers in the suggestion, to our legislators, of improvements in this very important, but greatly neglected, branch of British jurisprudence; we quite agree with the tenor of some remarks in his preface upon the subject.

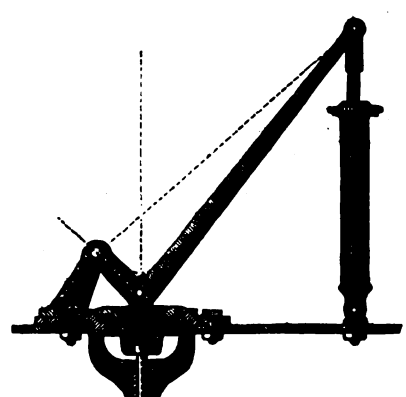
The book extends to 193 pages, nearly one-half of which is taken up with statutes, forms, &c. We cannot but think Mr. Crockford would have found the sale a much larger one than it is likely to be, had the book been produced at two-thirds its present price. It seems, too, to be a departure from the usual practice of the publisher of the "Law Times," whose books are generally produced at a moderate rate.

CORRESPONDENCE.

COMPENSATING LEVER SAFETY-VALVE.

As your readers have been directed to the subject of safety-valves in your last part, I venture to send you a pen-and-ink sketch of one, designed in 1846; the principal object of which is to overcome the defect of the common spring and lever valve, in which the tension on the spring increases as the valve rises, as is alluded to in page 150.

The sketch represents a safety-valve suitable for a locomotive, and its peculiarity consists in the bent lever, substituted for the ordinary straight one. The dotted lines show the true radial centres of the lever, and they are set at an angle of 45° with the vertical centre line of the valve; the result of which is, that as the valve lifts, the short arm of the lever acquires length, while the long one is shortened, so that the valve has more and more power over the spring, to compensate for the increased tension of the latter.



A safety-valve, fitted with an arrangement of oblique levers on the same principle, I have since found in the pages of the *Practical Mechanic and Engineer's Magazine;* it is by Mr. Charles Pemberton, and is called an "Isochronous Balance." It is rather more complicated than mine, but is a very effective instrument, and I think it is much to be regretted that some such modification of the compensating principle is not more generally used; for a spring is

in general much to be preferred to a weight for safety-valves, and there is no reason why it should not be as safe, as far as giving a free exit to the steam is concerned. For escape-valves to the cylinders of marine engines, a weight is particularly disadvantageous, as the valve requires to be set in action suddenly, to relieve a blow, and if a weight is used, its *vis inertia* has to be overcome, in addition to the pressure per square inch given to resist the steam.

ALADDIN.

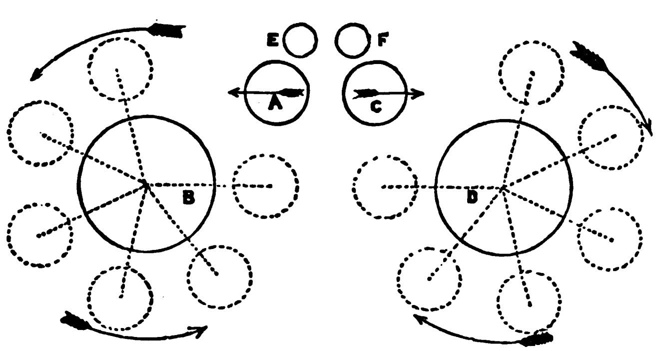
October, 1851.

REMARKS ON PLANETARY MOTION.

In considering the motions of the spheres of the solar system, it would first appear, that if these motions have been given them according to the knowledge we have of mechanical principles, then all the planets with their satellites, and also the sun, must, besides their revolutions, continually travel together in an undulating right line, so that in time they would be far from their present places; and astronomers have thought that some such movement actually takes place—though they conceive that, instead of a right line, it is an immense circle. I am not aware of any reason why it should be a circle; but that it should be an undulating right line seems to follow from the combination of forces, as precisely this effect might be produced by means of two bullets. Let a small bullet be attached by a long string to a large one, and let the small one be struck perpendicularly to the radial line of the large one; and the small one will then go onward as described, drawing the large one after it, gaining a step one way at every turn, and losing nothing the other, being then neutral on the large bullet, excepting in preventing its gaining ground at that time: that is to say, that it would then only prevent the increase, but add nothing; though, when on the other side, it would give a fresh pull at every turn; and the direction of the first impulse, however modified, could never be destroyed. If this then be the mode, *onward they must go together*.

But, on due reflection, such a progressive course seems untenable; because we know no possible means of giving such motions to the spheres by this method, without other bodies to react in the following way..

Let A be the earth, which has to revolve round the sun, B. In order, then, to give the earth, A, its first rectilinear impulse, let there be another sphere, C, at its side, and between A and C let some gunpowder be fired: and at *much greater distance* behind each sphere, let there be a sun, B, and a sun, D (the distance being measured in a perpendicular line to the two radii); also, let a string be attached between each sun and earth respectively, and an elastic string between the two suns; the explosion, then, might be so great, that the two earths should separate for ever in spite of their attraction—as the further two bodies are apart, the less is their attraction; for if the attraction were one pound at one mile, half a pound at two miles, quarter a pound at four miles, and so on,



it would never amount to two pounds in the given time. Therefore, let the explosion exceed two pounds, and the thing is done. When each earth, then, comes near each sun, the suns will attract them so as to cause each to wind round each (closer than such a string would allow), and each earth would accompany one sun, and go round it, the earths revolving contrarily to each other. This would cause the two suns and earths to recede from each other; but this may be counteracted in the heavens by the slight attraction between the two suns, one action tending to draw together, while the other tends to separate. The effect would, of course, be modified by there being several planets instead of one, but the difference would only be partial; and, in the course of time, all the planets might be considered as one at an average distance from the sun.

It may appear uncalled for to suppose there to be two of every sphere acting thus; but I have been drawn to this surmise, because it is the only way in which we could at all imitate the action; and in supposing any other mode, we suppose something without an example. We are utterly unable to give the smallest particle a motion one way, without giving an equal impulse in an opposite direction. If we propel a bullet of an ounce a mile in a minute, we must send a similar weight a mile contrary, or half an ounce two miles; or we must cause the reaction to be against the whole earth, which amounts to the same. When we fire a gun, it recoils with the same force as that of the bullet; and if the gun weighed no more than the bullet, and were no larger, it would shoot the shooter by the recoil, with the same force as the bullet flew forwards. Even when we walk one way, we cause the earth itself to go a little backwards. It seems to follow from this, that when the earth received its first impulse, an equal reaction must have followed on some other body; and this may be called an antagonist earth, which, if equal in bulk, would go just as much one way as the earth had gone the other. Some persons contend that this is not necessary, as God, they say, can give any motion to a body, without another body to act against. But God surely never does anything without using the proper means. It has also been objected that we gain nothing by the surmise, because we cannot ascertain how the spheres have been placed in their situation, and kept still against attraction, till the explosion may have come. Yet we are not obliged to reject that as a fact, because we cannot account for a prior fact; and the spheres may be retained in their position by the equal attraction of two suns in one line, and, if necessary, by some unperceived bodies in the other; while, from their great distance, they may be little influenced by either. It has also been said, that it seems as difficult to account for how a body should have been created in a place quite stationary, as that it should have been gifted with motion. But this objection seems rather beyond the limits of the subject. To know how a body has been created is beyond human power. But it appears quite illogical to object to an attempt to account for the first impulse of a body, because a difficulty exists as to how it should have been created without motion; because it must either have been one way or the other. If they were created *with* their motion, the thing was done, and we must then be satisfied by its having been the will of God; but, if created without motion, the business is to find out what has made them go. We do not even know that matter has had any beginning; and in attempting to solve this, we inadvertently fall into the attempt of discovering how matter had been taken from one place and accumulated in another, instead of considering its actual creation out of nothing, which to us, men, seems impossible; but it does not therefore follow that we are not to investigate the laws of motion, and though all motion seems to be only relative to the position of other bodies, different directions receive different impulses.

The revolution of the satellites, E F, round their spheres, would also result from the same explosion, as the impulse would be the same way, and the resistance in a similar way would proceed from a larger sphere.

Even the rotation about their own axes might result from the same explosion, by means of projecting irregularities (mountains or hills) for the explosion to act against, which effect would be the more if the spheres were heavier on the one side than on the other.

Another reason in favour of duplicate suns as well as worlds, is, that otherwise the explosion would only allow one of the worlds to have a sun at all, while the sunless world would be shot straight on into endless space. And a third reason is, that if there were only one sun, and if the earths were similar, and equidistant from the sun, they would come into collision at the reverse side of their course, unless their course were altered by some other agent. And if they were at unequal distances from the sun, they would probably fall on the sun.

The motion of comets also seems in favour of two suns, round which, as two foci (or round a spot near them), the comets revolve. Then the original propulsion of the comet would not have been from an explosion between it and another comet, as with the planets (so presumed), as then the two would strike together on the reverse side of their course, unless there be two suns to each of these comets, which seems improbable. The explosion must then, it would appear, have been between the sun itself and the comet, though possibly it might only be supposed to go round one of the suns, and round a spot very near the other sun (not quite reaching it). It has, I am aware, been demonstrated, that one sun alone is sufficient to cause the comet to describe its long ellipsis, though going slower and slower as it recedes from the sun; this being incontrovertible, allowing that the comet has once got its motion. But the question is, how has it come by its motion? and on this it hinges. If, then, as we have supposed, it had proceeded from an explosion between itself and the sun, it would have gone in a straight line instead of an ellipsis; but the influence of the other sun is here supposed to bend the motion into a curve.

It has also been said, in opposition to there being two suns, that astro-

nomers have calculated precisely the action by means of only one sun; and that, if there were two, the result would vary from their calculations, which have faithfully foretold the times of their return. But two suns would, it seems, not much alter the curvature nor the periods of return. Two suns would materially alter the velocity in different parts of the curve; but the total average velocity, if I am correct, would not differ whether there were two suns or one, if the velocity be owing to the first impulse, as appears to be the fact. And as the other sun is supposed to be very distant, the velocity of the comet would not be much altered by the other sun while the comet was in our region.

It is evident, that if there be two suns they must be at an immense distance apart, the one being perhaps seen here as a fixed star; and as some comets are judged to be above 3,000 years in their circuit, it would seem that they had ample time to reach some other star or sun—and Mitchel hints at such a probability in his excellent astronomical "Stellar Worlds." The greatness of the distance of the supposed other sun may seem so to deprive it of power, that it should not have sufficient influence either on our sun or on the comet, but a very slight attraction between two suns would prevent the suns from being drawn on by the planets; and with respect to the comets, it is not necessary for the other sun to act much on the comet while it is near us; and the less its attraction at that time, the less can the existence of two suns affect the calculations. But if the comet is properly directed, it would reach the second sun without even being attracted by it at all—yet, when it comes near it, the attraction will be great.

Far be it from me, however, to pretend that I have discovered the secret of the origin of the motion of the heavenly bodies: all I wish to be construed from these remarks is, that such a plan seems according to mechanical principles; and no other, materially different, offers itself to my mind, nor has ever been explained to me. Explosions may seem too violent a mode to have been the means; but as the surfaces are large, the explosions need not be violent, they may have been merely a force a little exceeding gravity. And besides this, they may possibly have evolved the gas forming an atmosphere. An opinion from a high source has been offered me, that the motions may have been generated by attraction alone, which I would not presume to deny; but I do confess myself sceptical on this point, no mode of effecting such rotations by means of attraction alone having accompanied this opinion. And the great Maclaurin seems also averse to such a theory. I cannot, indeed, form any idea as to how rotation can be produced by attraction alone, as it seems to me that all the bodies attracting each other would at last come together and there stop; which might be tried by hanging a number of magnetic needles on a string near each other, when it will be seen whether rotation can be thereby produced, and if I am correct, it will be found impossible. How then are we to account for the first impulse, but by the method described?

There may be some difficulty in supposing that the satellites had been visited with an explosion just at the same moment as their respective larger spheres; but the explosion of the one may have produced the other, or if it had begun with the satellites, these being small, would not thereby draw the large bodies very fast out of their places.

It must not, however, for a moment be supposed, that I have presumed in any way to impugn the theories of the motions of the spheres as established by the talented mathematicians who have deduced them; but mathematicians do not much, if at all, allude to the production of the prior impulse; this being the principal subject of these remarks. Mathematicians say with truth, that one sun is sufficient to cause a comet to revolve in a long ellipsis, the sun being at one end; but they do not show the direction of the first impulse—and as one sun would also be sufficient to cause a comet to revolve in a very elongated course, the sun being in the centre, we have to trace the reason why the sun is not in the middle of the course. To what else, then, can we look for this, but to the first impulse? which, with respect to comets, seems to have arisen from an explosion between them and the sun. And here we are led to look for another sun, to bend the motion from a right line into a curve. An objection has been made to there being two suns, on the ground that, before the action of the planets on them, they must have attracted each other together. On this objection I cannot offer any decided opinion; but as great a difficulty appears to exist, to say why the fixed stars do not all come together—still they do not.

L. G.

London, 1851.

REMARKS ON HEAT.

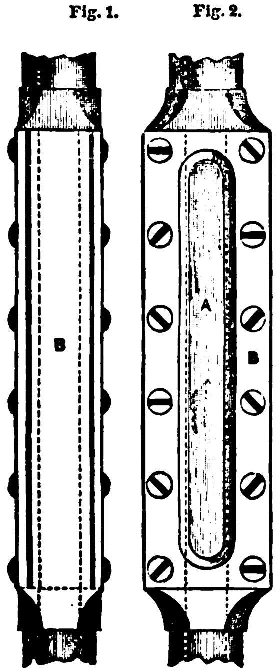
It is generally considered that the particles of heat repel each other; first, because heat radiates; and secondly, because expansion arises from increase of temperature. But these circumstances do not seem sufficient evidence of such being the fact. If the particles did repel each other, the further the place were from the fire, the faster would the heat travel; as the first particle would urge on the second, the second the third, and so on; the speed of each being increased by the impulse of the one behind it. If, then, we find that heat does proceed *faster* the *further* it is from the fire, we may conclude that the particles do repel each other; if not, we may rest satisfied that they do not. And with respect to the enlargement of bodies by heat, this only proves that heat, like other things, requires space to dwell in.

London, 1851. L. G.

GOODFELLOW'S TALC STEAM GUAGE.

The insecurity of the common glass tube guages, from the liability to fracture, whether from accident or change of temperature, has led me to substitute talc as the transparent medium for showing the water-level in place of glass. This guage, which I have exhibited in Class 5, No. 778, of the Great Exhibition, and have had working in H.M. dockyard at Devonport, under a steam pressure of 50 lbs., for the last twelve months, is delineated in the annexed figures. Fig. 1 is a side, and fig. 2 a front view of the guage.

Fig. 1. Fig. 2.



1-3rd.

The talc, A, is secured to an oblong box, B, by two plates of metal, having an opening in each, and thus forming, as it were, two windows through which the rise and fall of the boiler water-level may be easily seen. The ends of the box are made round, so that the "talc guage" may be easily attached to the ordinary fittings of the glass tubes.

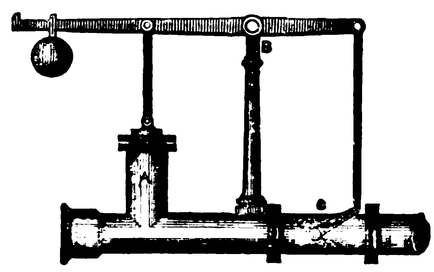
The transparency of talc, with its power of standing high temperatures and sudden changes, as well as great pressures, render it peculiarly suitable for the purpose to which I have applied it. Under a water-pressure test, a guage, having an aperture 6 inches long, and ⅜th inch wide, with talc $\frac{1}{16}$th of an inch in thickness, resisted a pressure of 200 lbs. per square inch. For locomotive and marine boilers, where the liability to accident is so great, the superior strength of the new material is of the greatest importance, and as a means of viewing the internal operations of steam boilers it is remarkably useful, when placed in the iron plate, on opposite sides of the boiler, so as to afford a light through from side to side.

JAMES GOODFELLOW.

Devonport, October, 1851.

SELF-ACTING STEAM-PRESSURE REGULATOR.

As I have observed, in the *Practical Mechanic's Journal*, several arrangements of apparatus for obtaining low-pressure steam from a high-pressure boiler, by Mr. D. Auld, I have taken the liberty of forwarding you a sketch of an arrangement for a similar purpose, which I have had in operation at the Cook Street Works, Glasgow, for nearly two years. My sketch is a side elevation of the apparatus. A short cylinder, A, opens at its bottom into a horizontal steam-pipe, and has fitted within it a steam-tight plunger, a rod from which passes upwards to an overhead lever, working on a fixed centre at B. The opposite arm of the lever is linked to a throttle-valve, C, in the the steam-pipe, so that the action of the steam in the cylinder, A, in elevating the plunger, proportionally closes the valve, C. To balance the steam-pressure on the plunger, a weight is hung to the long arm of the lever to which the plunger link is jointed. The effect of this simple



arrangement is pretty obvious. When once adjusted to the required low pressure, it is immaterial how far the initial high pressure in the boiler may vary, inasmuch as the greater or less pressure will carry up the plunger more or less, and thus keep the valve, c, at the proper extent of opening for the fixed amount of low pressure. By it, high and low pressure engines may be worked from the same boiler. In the instance where I have applied it, it produces low-pressure steam for the troughs of dressing machines.

JOHN REID.

Glasgow, 1851.

LOCOMOTIVE MECHANISM IN THE GREAT EXHIBITION.

THE "HAWTHORN" LOCOMOTIVE.—SHARP'S SLIDE-VALVE.—THE "FISHED" RAIL JOINT.

It is with some interest that I have perused your article on this subject in your number for October. I beg to offer a few remarks on the inventions therein noted.

First, As to the mode adopted by Hawthorn for suspending the engine. His object is to equilibrate the load on the wheels by compensating beams, so as to render the separate loads practically independent of irregularities in the rail. The object, I have no doubt, is perfectly accomplished, so long as the engine is prevented from pitching. Now, it occurs to me there is a great objection to the concentration of the suspended weight on four points (at the buckles of the springs), so closely situated as to form, according to your drawing—of which, however, there is no scale appended—a rectangle of suspension only 7½ feet long, by about 7 feet wide; whereas the total length of the engine over the frame is 24 feet, or three times the suspended length. And it so happens in locomotives, that the greater parts of the weight are distributed towards the ends. Thus there is a powerful inducement, by the overhanging of these pendulous masses, to excessive pitching at high speeds, which I apprehend is the worst kind of instability. It has been a commonly received axiom, that the steadiness of an engine running is, *cæteris paribus*, as the rectangle covered by the wheels. But in the enunciation of this aphorism, it was implied that the elastic base was of the same length. In the Hawthorn, the elastic area is reduced to one-half the length covered by the wheels, and in this serious reduction lies, I think, the main objection to the mode of suspension. But the objection becomes still more conspicuous, when we reflect that there is no practical advantage in so linking the three bearings on each side. In a four-wheel engine, we know the weight on each axle is invariable, and no adjustment of the springs can sensibly affect it. Had Mr. Hawthorn been content with equilibrating only the driving and hind axles, reserving independent springs for the leading wheels, he would have gained the advantage of an unalterable disposition of the weight on the wheels, without any material sacrifice of elastic base.

Secondly, Of the *equilibrium slides* of Hawthorn. The object proposed is a very desirable one, to relieve the valve of pressure on the back. This is a step in the right direction, and should the valve now proposed be found to wear well, it will be an acquisition.

Thirdly, As to Hawthorn's *expansion link*. Barring the method of the four eccentrics, which was a decided hit, Hawthorn has done little for the substantial improvement of valve-gear; and what has he gained in the link before us? In the first place, he states that he lowers the boiler; but, by the drawing, the centre of the boiler stands 6½ feet off the rail; and if we take Hawthorn's own engine, published in the last edition of Tredgold, with a wheel 6 inches larger, the centre of the boiler is only 6 feet off the rail; or, take Fairbairn's engine, as published in Clark's Railway Machinery, it stands just 6 feet ½ inch from rail to centre of boiler, with a 5 feet 8 inch wheel; or take Wilson's engine, published in your own pages, the centre of the boiler stands just 6 feet off the rail, with a 6 feet driving wheel. Thus, there is sensibly nothing to be claimed for the new link on the score of a low centre of gravity. The designers were, no doubt, aware of this, for they have studied to connect the ends of the eccentric-rods as near to each other as could practically be done consistently with a fair action—namely, 8½ inches apart, according to the detail, which, I presume, is done to a 1½ inch scale. A wide connection of the rod-ends is in all cases desirable, and I think the worst feature of the new link is the proximity of the connection. The removal of the weight of the link off the reversing-gear is a crumb of comfort, but we all know that the moving weights may be balanced, by which the labour of reversing is reduced to a minimum; and, besides, it has been overlooked, that the link may be, and is, in many valve motions, suspended, and we have only the valve-rod link to move in reversing. Neither does this link yield a more perfect action of the valves. Pray, what is perfect action? I take it to mean, so far as link motions differ, that the lead is preserved constant for all grades of expansion, and that the steam is cut off equally for the front and back strokes of the piston. Now, with the new link, it is impossible to maintain a constant lead, for the lead increases with the expansion, and so far it is on a par with the ordinary shifting link; on the other hand, the stationary link, such as is employed on the Great Western Railway, *preserves the lead constant;* and in so far it is superior to the new link. Moreover, in all links, the same facilities exist for securing an equal cut-off for the two ends of the cylinder.

A few words with Mr. Sharp. He proceeds on the assumption, that the exhaust passages for steam in the locomotive are insufficient for the timely escape of the steam. Now, first of all, has he ever proved it experimentally? for his arguments are not sound. He assumes that the velocity of piston is generally as much as 1000 feet per minute. This speed is only attained with express trains; 600 feet per minute is nearer the ordinary speeds. However, let that pass. He infers that, because speeds are five times what they were, and that the working steam-pressure is doubled, forty times the area of exhaust is now necessary to secure the same freedom of exit. Now, this is assuming, first, that the old exhaust passages are just big enough, and no more, to set free the steam; and secondly, that the higher the pressure of steam to be exhausted, the greater, *in the same proportion*, is the effort of exhaust. Now, in fact, the velocity with which steam flows freely into the atmosphere, *increases* with the pressure; 1 lb. steam, when unobstructed, flows out at 482 feet per second; 5 lbs. steam, at 973 feet; 10 lbs. steam, at 1,241 feet; and 100 lbs. steam, at 1,957 feet per second. These are speeds very much greater than would ever be required in practice for making a speedy exhaust. Let us take, for example, the case of the Great Western 8-wheel engines, with which, probably, Mr. Sharp is most conversant. Their blast orifices run about $\frac{1}{12}$th of the area of cylinder; therefore, for the steam to fly before the piston with sufficient celerity to give a free exhaust, it must leave the orifice at twelve times the speed of piston. Take 1,000 feet of piston per minute as the maximum, then 12,000 feet per minute is the minimum required speed at the orifice. But we have seen that even 1 lb. steam flows freely at about 500 feet per second, or 30,000 feet per minute, which is 2½ times the maximum speed ever required in practice. I attach little value to these conclusions, without allowances for practical obstruction; but they show that, on Mr. Sharp's own mode of argument, from general considerations, nothing like back pressure can take place. But he has favoured us with a numerical value of back pressures, and assigns 40 lbs. of back pressure for 100 lbs. of steam pressure. This is mere absurdity, as Mr. Sharp will find, if he appeals to the evidence of the indicator; and happily I am enabled to quote an admirable instance in point, from the fourth number of Clark's work already referred to, which contains a valuable series of steam diagrams from the Great Britain, one of the engines of the Great Western Railway, taken at various speeds, and as high as 60 miles an hour, or about 900 feet of piston per minute. Referring to the second series of these diagrams, with a 5½ inch blast orifice for an 18 inch cylinder, in the ratio of 1 to 10·7, we find that, in full gear, with 90 lbs. steam, at 54 miles an hour, the back pressure due to imperfect exhaust is not above 10 lbs. per square inch. Again, in the 5th notch, cutting off at 7 inches out of 24 inches of stroke, with 90 lbs. steam, at 56 miles an hour, the back pressure due to imperfect exhaust is actually nothing! I would therefore suggest that Mr. Sharp should reconsider the necessities of the case. These instructive diagrams also show, that if we take care to provide a free exhaust by the end of the steam-stroke, we may safely leave the valve to close the exhaust port after its own fashion.

I turn with pleasure to your notice of Adams' fish-joint for railways. This is one of the most sensible things ever brought out; and if our railway pioneers, generally, would recur, like Mr. Adams, to first principles, with the same judicious feeling for practical necessities, the gain to the railway world it would be hardly possible to over-estimate.

HELIX JUNIOR.

October, 1851.

[Whilst we cannot but feel gratified at the careful manner in which our friend "Helix Junior" has studied the paper here discussed, we must forbear congratulating him on the results of his examination.

In the first place, he ignores the very possibility of an arrangement so obvious, that we did not deem it necessary to go into it in the paper in question. It is—that the compensating beams may have their centres of pressure so arranged, as to place any required weight upon their different wheels. Messrs. Hawthorn have taken care to mention this in their specification; we here repeat it for "Helix Junior's" benefit, who, by the way, is strangely forgetful of the very important fact, that Messrs. Hawthorn's plan secures a constant amount of weight upon the driving wheels.

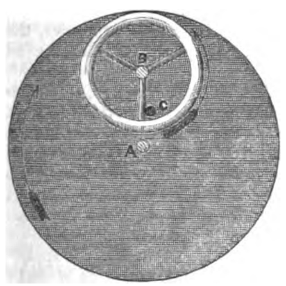
The second head appears to have passed muster unchallenged by our correspondent, we may therefore pass to the third. As regards the height of the boiler in the example of the "Hawthorn," we may quote the makers' remarks in their printed statement circulated during the exhibition of the engine. "It was Messrs. Hawthorn's intention to send a different description of engine to the Exhibition—one of greater novelty, and more generally adapted to branch and other lines of railway, for mixed trains, and where high speed is not of so much importance; but the limited period first fixed for the reception of machinery by the Executive Committee, deterred Messrs. Hawthorn from proceeding with the engine, or any other engine, for nearly a month, when the Committee communicated to them that the period would be extended; and, to meet their wishes, Messrs. Hawthorn had then no other alternative than to complete the engine now sent to the Exhibition (having the materials on hand), which they did in an inconceivably short time, and into which they introduced their patent improvements." Hence the advantages of the several improvements are not fully manifested in the "Hawthorn"—the height and general configuration of the engine having been long previously arranged.

An editorial note is hardly the place for an elaborate discussion of the link motion, or for a studied reply to his query—"Pray, what is perfect action?" If he does not find an echo elsewhere, he may "take it to mean" anything he likes, until we have an opportunity of giving him a lesson.

We shall leave Mr. Sharp to give his own reply, and meanwhile bid "Helix Junior" farewell.—Ed. P. M. Journal.]

ROTATION OF THE EARTH.

I see, in your September number, a plan by J. B., Dunfermline, for demonstrating the earth's motion. I think if he could make his machine perfect without friction, the experiment would be unsuccessful, unless J. B. could by some means contrive to stop the earth's rotation whilst he got his beam to rest; then, on starting again, the beam would appear to move. The following illustration will, I think, be satisfactory. Take a flat disc, and let it turn on the centre, A, and set upon it a wheel which turns on the pivot, B, in the disc. Then, if we turn the disc in the direction indicated by the arrow, the wheel would appear to revolve in the opposite direction. But if we put a pin, C, in the disc, so as to hold the wheel, and cause it to revolve with the disc, then, whilst in motion, draw out the pin,—now the wheel will not appear to revolve as before, but it will revolve in reality. So it would be with the beam on the surface of the earth.



O. T.

Sept., 1851.

HAND-BRAKE FOR PREVENTION OF MINE ACCIDENTS.

In my communication on this subject, given in the *Practical Mechanic's Journal* for last month, there are two errata, which I shall be glad to see corrected.

Eighth line from top, for "chipping," read "clipping;" and four lines further on, for "curve," read "corve."

F. Edensis.

[We plead guilty to the charge of misprints, and whilst we correct them, may add a few comments on our correspondent's original note.

In the first place, we think any practical miner will tell him that a "hand-brake" which he proposes, would be practically useless in cases of accident; for the simple reason, that the men in the cage would be paralysed by the instantaneous rapidity of their descent into the yawning gulf beneath them. There is no time for thought—still less for that preservative action which must be the result of thought; and we suspect the cage with its unfortunate occupants would be dashed to the bottom of the shaft, long before that prostrating nervous dread, which, by the way, would be magnified as the awful rate of descent increased, would allow of attention to any retarding power. Again, supposing the men capable of immediate attention to the brake, the stopping action could hardly be brought to bear, before the cage would have acquired an amount of momentum which no brake would overcome. We are not wholly unacquainted with the realities of the dangers surrounding the miner's operations; and to our thinking, the ordinary working rate at which the cages are lowered in many mines is quite enough to make most men a little nervous, for we frequently find ourselves at the bottom before we well know what we are about. But what is such a descent in comparison with that of a ponderous load descending through free space?

He refers to Fourdrinier's safety apparatus, but overlooks a much simpler and more effective apparatus, published not long ago in the pages of this *Journal*.* In Messrs. White & Grant's arrangements, provision is made, as well for the failure of the rope or any detail of the supporting apparatus, as for that more frequent source of danger, overwinding. And this provision, let it be remembered, is not hemmed in by mechanical complexities, which work well enough for an experimental review, and are fatally awkward on the first show of real danger; but is, perhaps, as effectively contrived, and as certain in its action, as it is possible for us to imagine. In the numerous instances where it has been applied—some 200 cages having been fitted with it by the patentees—not one failure is on record. No sooner does the rope give way, or the cage approach too near the overhead-pulleys, than the eccentric pulleys at once firmly grasp the timber guides. Our correspondent has referred to the Malago accident; and perhaps he could not have selected a case which more clearly points to the necessity of at once adopting the simple and effective means which mining proprietors now have within such easy reach. Whilst we write, we have the evidence in this very case before us, showing that, although the rope had been spliced and re-spliced, and was faulty to the last degree, yet were the unfortunate men taken up and down by it without the slightest precautionary safeguard. Not long after this accident, which consigned five people to destruction, the Kingswood collieries in the same neighbourhood, Bristol, were the scene of another fatality, owing to overwinding. According to the statement of the engine-man, all went right until the cage, with nine men in it, neared the mouth of the shaft. At this juncture, "the bolt of the reversing handle of the engine broke short off." Fully alive to the serious consequences which must ensue, the man caught hold of the eccentric rod itself, and tried to throw it out of gear. He failed in doing this, and the cage was therefore drawn up right over the pulley, one man being precipitated from it down the shaft, 147 fathoms deep, whilst the rest were variously mutilated.

Will any one deny, that, with Messrs. White & Grant's apparatus, both these accidents would have been prevented? Yet here, in this mechanical country, we have hundreds of pits working under circumstances precisely similar; and hence arises that stereotyped line of the newspapers, "Another fatal colliery accident."—Ed. P. M. Journal.]

INSTITUTION OF MECHANICAL ENGINEERS.

July 30th, 1851.

At the general meeting held this day, the following papers were read:—

"On Improvements in the Construction of Railway Waggons," by Mr. H. H. Henson.

"On a new Regenerative Condenser for High and Low Pressure Steam-Engines," by Mr. C. W. Siemens.

The condenser of a steam-engine has for its object the complete discharge of steam from within the working cylinder, after it has served to propel the piston. This is effected by conducting the expended steam into a closed chamber, containing an extended surface of comparatively cool substance, which absorbs the latent heat of the steam, and thereby reduces it to its liquid state. Cold water is generally employed for this purpose, which is either brought into immediate contact with the steam, as is the case in Watt's injection condenser, or through the medium of metallic walls, as in the surface condenser by Hornblower, improved upon by Hall and others.

The more or less perfect condensation of the steam depends—

First, On the absence of air from the condenser.

Secondly, On the temperature at which condensation takes place.

The appended table† shows the elastic force of steam in vapour at various temperatures. It will be observed, that in order to produce a perfect vacuum, the water should leave the condenser at about 32° Fahr., or be introduced in the form of ice. Condensing water, however, is generally obtained at the temperature of about 60° Fahr., and it leaves the condenser at about 110° Fahr., which latter temperature implies a remaining atmosphere of vapour equal to 2·5 inches of mercury, or, in other words, a vacuum of 27·5 inches below the atmospheric pressure at 30 inches. If a less quantity of condensing water be used, it will be raised to a proportionately higher temperature, and a less perfect condensation be effected. At 212° Fahr., the pressure of the uncondensed vapour would be equal to that of the atmosphere, and the object of the condenser would be entirely frustrated.

In all cases where an abundant supply of condensing water cannot be obtained, or where the heat of the steam employed by the engine is reclaimed for other purposes, steam-engines are worked without a condensing apparatus (or at high pressure), at the sacrifice of an effective pressure nearly equal to that of the atmosphere

* See Page 193, Vol. III.

† To be given in the latter section of the paper.

upon the working piston. The *Regenerative Condenser* (the subject of the present paper) redeems the engine from this waste of heat in the one case, and loss of mechanical effect in the other case, being possessed of the peculiar property of returning the condensing and condensed water at the initial temperature of the steam previous to its discharge from the working cylinder (commonly speaking, at 212° Fahr.), effecting nevertheless an efficient vacuum.

This condenser, in its application to high-pressure engines, consists of an upright rectangular trunk of cast-iron, the lower end of which is cylindrical, and contains a working piston. The trunk is filled with metallic plates, which are placed upright, and parallel to each other, with intervening spaces of not less than $\frac{1}{16}$th of an inch in breadth. The upper extremity of the condenser communicates on one side with the exhaust-port of the engine, and on the other with the hot well, through a valve. A stop prevents the opening of the valve beyond a certain distance, in order that it may re-shut more instantaneously. The metallic plates are fastened together by five or more thin bolts, with small washers between the adjacent plates, which keep them the required distance apart. They can easily be removed from the condenser for the purpose of cleaning, by taking off the cover, and drawing out the whole of the plates.

An injection pipe enters the condenser immediately below the plates; it is provided with a small air-vessel, and a regulating cock.

The action of the condenser is as follows:—

Motion is given to its working piston by the engine, causing it to accomplish two strokes for every one of the engine.

At the moment when the exhaust-port of the engine opens, the plates are completely immersed in water, a small portion of which has entered the passage above the plates, and is, together with the air present, carried off by the rush of steam through the valve into the hot well, where the water remains, while the excess of steam proceeds into the atmosphere. An instant after the partial discharge of the steam cylinder has commenced, the water recedes between the plates, and exposes them gradually to the steam, which condenses on them in the manner following:— The upper edges of the plates, emerging first from the receding water, are enveloped in steam of atmospheric pressure, and in condensing a portion thereof, they become rapidly heated to nearly the temperature of the steam, or about 210° Fahrenheit. The partial condensation diminishes the density and temperature of the remaining steam, which requires additional and cooler surfaces for its further condensation. This is provided for by the continual emerging of additional portions of the metallic surfaces from the water. By the time the water-level leaves the plates, the far greater portion of the steam is condensed. The condensation of the remaining portion of steam could not so readily be accomplished by means of metallic surfaces; but the piston continuing to descend, puts it into immediate contact with the jet of cold water from the pipe, which completes the vacuum in the manner of a common injection condenser. The air-vessel connected with the injection pipe has the effect of accumulating the injection water at the time when the water has ascended between the plates, and of forcing it into the condenser with increased intensity at the time when it is required to complete the vacuum.

Although the action of this condenser is strictly consecutive, yet it does not check the continuous flow of steam from the cylinder, and it completes the vacuum when the working piston of the engine has only accomplished one-tenth part of its stroke. Both the engine-crank and the crank driving the condenser are on the top centre at the same moment, but the latter completes its revolution in the time of half a revolution of the engine; consequently, when the engine-piston has passed only one-tenth of the whole stroke, the condenser-crank will have travelled through nearly half its stroke, when the whole process of condensation will have been completed. The principal part of the latent heat of the steam is stored up in the plates, the upper extremities of which are heated to 210° Fahrenheit, and the lower to about 150° Fahrenheit.

The water, in re-ascending between the plates during the last tenth part of the stroke, absorbs heat therefrom in a similar successive manner, passing first the coolest, and by degrees the hottest portions of their surfaces, and issues finally into the upper steam passage at a temperature approaching the boiling point, at which moment a fresh discharge of steam takes place, which carries it off into the hot well, as above described, and raises its temperature fully to the boiling point.

Various modes have been provided to give motion to the displacing cylinder, among which a knee-motion, worked directly from the beam or cross-head of the engine, is generally found the most convenient, as shown at M M in the engraving, further on.

The quantity of condensing water required with this condenser to condense one pound of steam of atmospheric pressure—taking the initial temperature of condensing water at 60° Fahrenheit, the final temperature at 210° Fahrenheit, the latent heat of steam of 212° Fahrenheit, at 960 units—is $\frac{960}{210-60}=6{\cdot}6$ lbs. of water to condense 1 lb. of steam.

The common injection condenser (supposing the condensing and condensed water to issue at 110° Fahrenheit) requires $\frac{960+(212-110)}{110-60}=21{\cdot}2$ lbs., in place of the 6·6 lbs. which the regenerative condenser requires. In the case of a locomotive, or other high-pressure engine, where the steam is released from the cylinder at a pressure of, say 30 lbs. above the pressure of the atmosphere, two-thirds would be allowed to escape uncondensed, and a vacuum be obtained with only $\frac{66}{3}=2{\cdot}2$ lbs. of condensing water for every 1 lb. of steam passed through the cylinder.

The small quantity of condensing water required, renders the proposed condenser applicable to engines in nearly every locality; and pains have been taken to render the apparatus itself equally light and compact. The advantages resulting from its application to high-pressure engines are as follow:—

1. Additional effective power, gained on account of the vacuum.

Fig. 3 illustrates this gain, which (supposing the average steam pressure to be = 40 lbs. above the atmosphere, and vacuum within the cylinder = 10 lbs.) amounts to 20 per cent., irrespective of expansion. If both the steam pressure and the duty on the engine remain unchanged after the condenser is applied, it is evident that the steam may be worked expansively to a large extent, without diminishing the absolute driving power of the engine.

2. Heat saved in generating the steam, by the use of *boiling hot feed-water;* and the remaining portion of hot water may be advantageously used for heating buildings, dyeing, &c.

High-pressure engines are frequently provided with heating apparatus for the feed-water, which heats it on the average to about the temperature of the condensing water from low-pressure engines, or 110° Fahrenheit. The proposed condenser heats it to 210° Fahrenheit, which constitutes a saving of $\frac{210-110}{960}=$ about 10 per cent.

When such heating apparatus is not provided, the saving amounts to $\frac{210-60}{960}$ = about 15 per cent.

3. The steam which is not condensed may be used to cause a draught in the chimney, or for other purposes.

4. The displacing cylinder, unlike the air-pump of the injection condenser, abstracts no motive power from the engine.

5. The condenser may be started and stopped at any time, by turning the supply of injection water either on or off. If turned on, it at once forms the vacuum without involving the necessity of blowing through; and if turned off, it allows the engine to proceed in the same manner as though no condenser had been applied.

6. The air contained in the condenser is, at the commencement of each stroke, *bodily expelled*, which is of great advantage to the formation of a good vacuum, instead of the ordinary air-pump removing only a portion of the air at each stroke, and consequently leaving a portion always in the condenser.

7. The regenerative condenser is more compact, and even less expensive, than the ordinary injection condenser, being less than one quarter of the size, and having only one valve instead of three.

Its proportionate dimensions are as follow:—Area of plate-chamber, three times the area of the exhaust-pipe; length of plates, one-quarter to one-third of length of stroke of engine; thickness of plates, $\frac{1}{192}$nd part of this length. Spaces between the plates, the same, but never less than $\frac{1}{16}$th of an inch, it having been found that the alternate rush of water and condensing steam prevents the settlement of grease and earthy matter between the plates, if they are not less than $\frac{1}{16}$th of an inch apart. Capacity of displacing cylinder, equal to one and a half times the capacity of the plate-chamber. The total capacity of the condenser is only equal to about the tenth part of the capacity of the working cylinder. In applying the regenerative condenser to existing high-pressure engines, a saving of fuel of from 30 to 35 per cent. has been effected, or an increase of power to that amount with the same expenditure of fuel as theretofore. This saving may, however, be still considerably augmented, if advantage be taken of the increased effective pressure to work the engine expansively. This may, in most cases, be easily effected, by merely adding to the lap of the slide valve, and increasing the lead of the eccentric proportionately, whereby the additional advantage of a more early discharge of the steam is obtained.

The advantages attending the application of the regenerative condenser to stationary engines being practically proved, the author is desirous to extend the same also to that important class, the locomotive engine. In inviting the attention of railway engineers to this inquiry, he is prepared for practical objections being raised, on account of the great rapidity of motion, the necessity for the greatest possible simplicity and lightness, the deficiency of condensing water, &c.; but he thinks that the condenser under consideration is peculiarly well adapted to meet these objections.

Its peculiarities in this respect are:—That it may be accommodated to any speed of piston, by reducing the length and increasing the breadth of plates, thus reducing the velocity of the displacing piston proportionately.

Its dimensions are proportionate to the capacity of cylinder only, and not (like other condensers) to the horse-power of the engine.

The total weight of a pair of condensers, as applied to a locomotive engine with cylinders of 13 inches diameter and 20 inches stroke, is about $3\frac{1}{2}$ cwt.

The power of the blast remains nearly undiminished.

The condenser requires no attention in working the engine, and in case it should fail to act from any accidental cause, the engine will continue to work high-pressure as usual; moreover, it does not interfere with the working parts of the engine.

The advantages which would result from a vacuum in the cylinder of a locomotive engine, have been ably set forth by Mr. Edward Woods, in his "Observations on the Consumption of Fuel and Evaporation of Water in Locomotive and other Steam-Engines." The present paper may therefore be limited to the means proposed for that purpose.

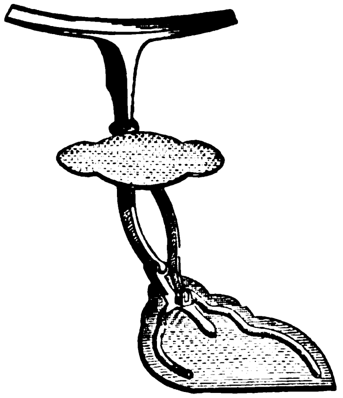
[We shall give some further examples of Mr. Siemens' invention next month.—Ed. P. M. J.]

"On a New Blowing Engine, working at High Velocities," by Mr. A. Slate.

"On an Improved Mode of Moulding Railway Chairs," by Mr. E. A. Cowper.

MONTHLY NOTES.

Rock's Simultaneous Double-Carriage Step.—This is one of a series of improvements in carriage mechanism recently patented by Mr. James Rock, jun., the carriage-builder of Hastings. The sketch represents the "simultaneous double-step" open for use. The point of the improvement is the connection of the upper and lower treads by means of the light link, A, by the action of which both treads are made to open, and that at the same time, and much more conveniently than in the ordinary double-step. With a carriage so fitted, the person inside has the power of opening and shutting the step himself, by moving the upper tread, which, in most cases, is within convenient reach. It may also be worked from the door, by attaching a lever to the back part of the upper tread. The design of the step, altogether, exhibits considerable elegance.



M. Evrard's Plan of Chemically Colouring the Positive Photographic Proof.—These colours are obtained by introducing into a bath composed of one part hyposulphite soda, to six parts water: first, a few drops of ammonia, this renders the bath alkaline, and produces a reddish sepia tone; second, a few drops of acetic acid, which renders the solution acid, and passes to a fine black through the violet tints. A somewhat similar effect is produced by the addition of a little nitric or sulphuric acid, but the whites are apt to spot; but in that case, by adding a very little acetic nitrate of silver, the tones are much blackened, and the effect is very good. It is for this reason that old hyposulphate solutions, impregnated with salts of silver, are much preferable for setting pictures than fresh ones. The first effect of old baths is to give firmness to the tints, the after effect is to thin them. If the action be prolonged beyond that limit a yellow tone is produced, as with all acid baths. By the use of several of these baths, the proof may be brought to a suitable tone: thus, if it is too deep, it may be reduced by exposure to an alkaline bath; if too light, to an acid bath; but the use of them demands some experience, and care must be taken not to pass a proof from an alkaline bath to an acid one, or *vice versa*, without first rendering it neuter by washing and then plunging it into a neutral solution of hyposulphite soda for a minute or two. By adding to the hyposulphite bath some crystals of acetate of lead, you get a reddish violet tone, very peculiar. In this case the proof must be placed in the solution of neutral hyposulphite of soda, and then passed into the bath just mentioned, avoiding the acid or alkaline baths. Afterwards, a deep violet tone is given by placing the proof in an acid bath, but the peculiar effect of the acetate of zinc is thus lost. The satisfactory use of these baths depends much on the state of the proof. If that be feeble, the decolourising effect of the baths soon deprives it of all vigour. If, on the contrary, it be very vigorous, the proof will support the bath perfectly, and duly improve under it, the whites becoming each moment clearer and clearer. It is therefore necessary, when it is proposed to expose a proof to the action of one of these baths, that it should be rather overdone than not. It must be understood that the proofs are first set in the ordinary hyposulphite bath.—*Croucher on Photography.*

The Anti-Friction Curve.—Our practical readers will learn, with some satisfaction, that this invention, to which we have devoted two papers, in the present and last parts of this *Journal*, has met with the unqualified approval of Col. Morin, the eminent French philosopher. As Director of the Conservatoire des Arts et Metiers, at Paris, Col. Morin selected several of the applications of the curve, from Mr. Schiele's collection at the Exhibition, for purchase by the French commissioners for this institution. Whilst we refer to the subject, we may amend some errors in our first paper, page 152, part 43—first col., line 21 from top, at "Equation : $x = m$, log." *dele* comma between m and log; second col., line 26 from top, for "along the full scope of the curve," read "allowing the full scope of the curve."

The Flax Culture in Scotland.—Flax (*linum usitatissimum*) has excited strongly the hopes of the Scottish farmer within these recent years; and we believe that the prejudices against its exhausting character as a crop, precluding it from rotations, and prescribing it in the covenants of every Scottish lease, must and will rapidly disappear before the glance of agricultural enlightenment and the achievements of science. The impression has hitherto been, that the richest soil was demanded for the growth of flax, and would inevitably be sacrificed to its culture, if introduced into the rotation oftener than once in twenty years. In the north, such men as Mr. Thomson of Banchory, and Sir James H. Dalrymple Elphinstone, were, nevertheless, ready to accept even the twenty years' rotation; but they experienced another difficulty: the culture of flax having fallen into fifty years' desuetude in Scotland, the parish steeping-pool and district scutching-mill had been abolished, and insuperable difficulties beset the preparation of the fibre. In the west, on the rich-bottomed lands of Lochwinnoch, the heavy crops of flax now raised are purchased in a green state by Irish agents, and the farmer relieved of this dilemma. We find, also, that Mr. Nelson of Greenwell Farm, near Falkirk, has, for the last two seasons, dissipated effectually the notion that none but the richest soil will answer for flax, by growing, successively, crops of seven and then of thirty acres, with the most unquestionable success, in the highest and most inhospitable wastes in the Scottish lowlands. The specimens of the flax, in its various stages, in our collection, were grown on the estate of Mr. Grant Duff of Eden, in Banffshire. Hemp (*cannabus sativa*), a native of a warm climate, is rather tender for cultivation in Scotland, though found growing in Suffolk and Lincolnshire. A tree mallow (*lavatera arborea*), however, capable of producing very strong fibre for making ropes, grows naturally on our sea rocks or cliffs, and is a native of the celebrated Bass Rock, in the Frith of Forth.—*Vegetable Products of Scotland.*

Rolling Stock of the South-Eastern Railway.—The rolling stock of this line amounts to 120 passenger engines, 34 goods engines, and 4 royal and saloon carriages, 136 first class and composite, 125 second class, and 101 third class carriages, 48 luggage vans, 66 horse boxes, 73 carriage trucks, 1 post-office carriage, 485 goods waggons, 58 cattle waggons, 891 timber, coke, coal, stone, and ballast waggons, and 12 brake vans.

A Queer File from Copenhagen.—A particularly "queer file," technically known as a "rubber equal'um," or large file of four equal flat sides, and 10 pounds weight, has been shown in the Exhibition as a Danish production. It is ornamented externally with the royal arms of Denmark, and views of public buildings in the Danish capital, cut with hammer and chisel. Its peculiarity consists in its being made hollow, to contain a large round file, which in turn contains a nest of others, packed like pill-boxes. There are about a dozen files altogether, the smallest hollow file being 1¼ inch long. It was made by a Mr. Naylor, who is the son of a Birmingham filesmith, and resides in Copenhagen.

Self-Regulating Drawing-Frame for Cotton Spinning.—Mr. W. Hayden, of the State of Connecticut, U.S., has recently specified an ingenious improvement in cotton machinery, which he terms "an improved regulator, or apparatus for regulating the draught of the sliver" in drawing-frames—the object being, to cause the variation in the volume of the sliver itself to speed the back drawing-rollers quicker or slower, in order to compensate for the irregularity on either side of the standard. He accomplishes his object by passing the sliver, as it emerges from the front drawing-rollers, through a funnel or trumpet-delivering mouth set on the upper end of a vertical oscillating lever. This trumpet is made of such a bore as to suit the required thickness of sliver, so that, when a thick piece occurs in the latter, the trumpet will be drawn forward, whilst any "single" will allow a counterweight to bring it back again. In this way the trumpet has an occasional slow oscillation, just as the irregularities arise; and it is this oscillation which is taken advantage of to adjust the rate of the back rollers. This is effected by connecting the opposite end of the trumpet-lever with a double cone drum arrangement, so that, as the trumpet falls back, the rollers are speeded quicker, whilst they are correspondingly retarded when the thickness of the sliver pulls the trumpet forward. If the movement were effected by some simpler means, it might be looked upon as a valuable acquisition to the mechanism of cotton spinning.

ENGLISH PATENTS.

Sealed from 25th September, to 16th October, 1851.

Frederick Hale Thomson, Berner's-street, Middlesex, gentleman, and George Foord Wardour-street, in the same county, chemists,—"Improvements in bending and annealing glass."—September 25th.

Charles Green, Birmingham, Warwick,—"Improvements in the manufacture of brass tubes."—25th.

Richard Archibald Brooman, of the firm of J. C. Robertson and Co., Fleet-street, London, patent agents,—"Improvements in presses and in pressing."—(Being a communication.)—25th.

Robert Roberts, Dolgelly, Merioneth, mine agent,—"An improved method of quarrying certain substances."—25th.

Charles Watt, Kennington, Surrey, chemist,—"Improvements in the decomposing of saline and other substances, and in separating their component parts, or some of them, from each other; also in the forming of certain compounds or combinations of substances, and also in the separating of metals from each other, and in freeing them from impurities."—25th.

James Garforth, Dukinfield, Chester, engineer,—"Certain improvements in locomotive steam-engines."—25th.

David Stephens Brown, Old Kent-road, Surrey, gentleman,—"An improved agricultural implement."—25th.

Ernst Kaemmerer, Blomberg, Prussia, ironfounder,—"Improvements in sowing, depositing, or distributing seeds over land."—25th.

William Hodge, St. Austell, Cornwall,—"Improvements in the manufacture of glass, china, porcelain, earthenware, and artificial stone."—October 2d.

William Henry Ritchie, Kennington, Surrey, gentleman,—"Improvements in ornamenting glass."—(Being a communication.)—2d.

Thomas Cussons, Bunhill-row,—"Improvements in ornamenting woven fabrics for bookbinding."—2d.

James Warren, Montague-place, Mile-end-road,—"Improvements applicable to railways and railway carriages, and improvements in paving."—2d.

Leman Baker Pitcher, Syracuse, New York, America, gentleman,—"Improvements in apparatus for regulating motive-power engines."—2d.

Thomas Taylor, Patent Saw-mills, Manchester. Lancaster,—"Improvements in apparatus for measuring water and other fluids."—9th.

Joseph Pimlott Oates, Lichfield, Stafford, surgeon,—"Certain improvements in machinery for manufacturing bricks, tiles, quarries, drain-pipes, and such other articles as are or may be made of clay or other plastic substance."—9th.

Sir John Scott Lillie, Knight-Companion of the Order of the Bath, of Pall-mall, Middlesex,—"Improvements in forming or covering roads, floors, doors, and other surfaces."—9th.

Henry Curzon, Kidderminster, Worcester, civil engineer,—"Improvements in the manufacture of carpets and rugs."—9th.

Henry Briggs, Primrose-street, Bishopsgate-street, seed-crusher,—"Improvements in oil lamps and in apparatus for lubricating machinery."—9th.

James Frederick Lackerstein, Kensington-square, Middlesex, gentleman,—"Improvements in obtaining motive power."—9th.

Robert James Maryon, York-road, Surrey, gentleman,—"Improvements in obtaining and applying motive power, and in signalizing."—10th.

Richard Archibald Brooman, of the firm of J. C. Robertson and Co., Fleet-street, Lon-

don, patent agents,—"Certain improvements in the preparation and treatment of fibrous and membraneous materials, both in the raw and manufactured state, whereby they are rendered more durable, are contracted or expanded, are cleaned, and are more capable of resisting decomposition, and of receiving and retaining colours."—(Being a communication.)—10th.

Hubert Sommelet, Paris, in the republic of France, manufacturer,—"Certain improvements in the manufacture of scissors."—10th.

Thomas Lightfoot, Jarrow Paper-mills, South Shields, Durham, paper manufacturer,—"Improvements in machinery applicable to the manufacture of paper."—16th.

Thomas Henry Fromings, of the firm of Lomas, Fromings, and Co., Sheffield, York, manufacturers,—"Improvements in forge hammers."—16th.

Matthew Gibson, Wellington-terrace, Newcastle-upon-Tyne,—"Improvements in machinery for pulverizing and preparing land."—16th.

William Onions, Southwark, Surrey, engineer,—"Improvements in the manufacture of nuts and bolts, also of steps, bearings, axles, and bushes, also of mills and dies for engravers, also of bells, lathe, and other spindles, also of weft-forks, shuttle tongues, and lips for looms, also parts of agricultural implements, chains, roller-guides, and throstle-bars, by the application of materials not hitherto used for such purposes."—16th.

Thomas Perry, Tower-street, Leicester, machinist,—"Improvements in the manufacture of looped fabrics."—16th.

Richard Dover, New-street, Spring-gardens, Westminster, merchant,—"Improvements in treating sewage, or obtaining products therefrom, and combining such products with other matters."—16th.

SCOTCH PATENTS.

Sealed from 22d September, to 22d October, 1851.

Richard Archibald Brooman, of the firm of J. C. Robertson & Co., 166 Fleet-street, London,—"Improved method of making screws."—(Communication.)—8th Sept.

John MacDowall, Walkinshaw Foundry, Johnstone, Renfrew,—"Improvements in cutting wood and other substances, and in the machinery or apparatus employed therein, and in the application of power to the same."—22d.

Henrietta Brown, Long-lane, Bermondsey, widow and executrix of the late Samuel Brown,—"Improvements in the manufacture of metallic casks and vessels."—24th.

Robert Newall, New York, America, lock manufacturer,—"Certain new and useful improvements in the construction of locks."—24th.

John Baker Pitcher, Syracuse, America, gentleman,—"Improvements in apparatus for regulating motive power engines."—24th.

John Wormald, Manchester,—"Improvements in machinery, or apparatus for spinning and doubling cotton, wool, silk, flax, or other fibrous substances."—29th.

Charles Watt, Kennington, Surrey, chemist,—"Improvements in decomposing of saline and other substances, and in separating their component parts, or some of them, from each other; also, in the forming of certain compounds or combinations of substances; and also in the separating of metals from each other, and in freeing them from impurities."—29th.

Thomas Kennedy, Kilmarnock, Ayr, North Britain, gun manufacturer,—"Improvements in measuring and registering the flow of water and other liquids."—29th.

Elijah Galloway, Southampton Buildings, Middlesex, civil engineer,—"Improvements in steam-engines."—30th.

William Johnson, Millbank, Westminster,—"Improvements in ascertaining the weight of goods."—Oct. 1st.

William Barker, Hulme, near Manchester, Lancaster, millwright, in the employ of Joshua Scholefield & Sons, fustian dyers and finishers, Cornbrook, near Manchester,—"Improvements in machinery for chipping, rasping, and shaving dyewood, and other materials, and in apparatus connected therewith."—6th.

Henry Curzon, Kidderminster, Worcester, civil engineer, "Improvements in the manufacture of carpets and rugs."—10th.

Thomas Lightfoot, Jarrow paper mills, Durham, paper manufacturer,—"Improvements in machinery applicable to the making of paper."—10th.

George Robins Booth, Portland-place, Wandsworth-road, Surrey,—"Improvements in generating and applying heat."—15th.

William Onions, Southwark, Surrey, engineer,—"Improvements in the manufacture of steel."—15th.

Henry John Betjeman, Upper Ashby street, Northampton-square, Middlesex,—"Improvements in connecting parts of bedsteads, and other frames, and in machinery employed therein."—16th.

Daniel Dalton, Spon-lane, Westbromwich, Stafford, ironfounder,—"Improvements applicable to railways."—16th.

William Jean Jules Varillat, Rouen, in the republic of France, manufacturer,—"Improvements in the extraction and preparation of colouring, tanning, and saccharine matters from vegetable substances, and the apparatus to be used therein."—20th.

William Onions, Southwark, Surrey, engineer,—"Improvements in the manufacture of nuts and bolts, also of steps, bearings, axles, and bushes, also of mills and dies for engravers, also of bells, lathe, and other spindles, also of weft forks, shuttle tongues, and lips for looms, also parts of agricultural implements, chains, roller guides, and throstle bars, by the application of materials not hitherto used for such purposes."—20th.

Thomas Sanders Bale, Cauldon-place, Stafford, china manufacturer,—"Certain improvements in the method of treating, ornamenting, and preserving buildings and edifices, which said improvements are also applicable to other similar purposes."—20th.

Robert Griffiths, Havre, engineer,—"Improvements in steam-engines, and in propelling vessels."—21st.

Frederick William Mowbray, Leicester, gentleman,—"Improvements in machinery for weaving."—21st.

William Fawcett, Kidderminster, Worcester,—"Certain improvements in the manufacture of carpets."—21st.

George Fergusson Wilson, managing director of prices, Patent Candle Company, Vauxhall, David Wilson, Wandsworth, Esq., and James Child, Putney, Esq.,—"Improvements in presses and matting, and in the process of, and apparatus for, treating fatty and oily matters, and in the manufacture of candles and night lights."—22d.

Donald Henderson, Glasgow, ironmonger,—"An improved apparatus for generating gas, which apparatus may be used for heating, and other similar purposes, and other apparatus for heating and ventillating."—22d.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 18th September, to 16th October, 1851.

Sept. 18th,	2946.	Henry S. Rogers, New Oxford-street,—"Eye renovator."
—	2947.	R. and W. Wilson, Wardour-street, Soho,—"Bath heater."
—	2948.	R. Sorby, R. Sorby, jun., and T. A. Sorby, Sheffield,—"Point for scythes."
—	2949.	R. Sorby, R. Sorby, jun., and T. A. Sorby, Sheffield,—"Point for a reaping-hook."
19th,	2950.	W. Scott, Exeter,—"Air-regulator, with air-strainer for the admission of pure air into apartments without a draught."
—	2951.	T. Cook, Plumstead, and W. J. Corsan, Shadwell,—"Alarum for houses."
—	2952.	Robert Hammond, Kirkgate, York,—"General two-horse reaping machine."
19th,	2953.	James Guest, Birmingham,—"Penholder."
—	2954.	The Grangemouth Coal Company, Grangemouth, Falkirk,—"Drain-pipe, chair, and sleeper."
22d,	2955.	The Rev. E. H. Johnson, Lindfield, Sussex,—"Skim plough."
23d,	2956.	S. A. Bell and J. Black, Bow-lane, Cheapside,—"Matchless match-box."
—	2957.	Joseph Taylor, Wolverhampton,—"Tittley's protection segmental slide-cap for locks.
—	2958.	Henry M'Evoy, Birmingham,—"Hooks for dress fastenings."
—	2959.	Beach and Minte, Birmingham,—"Inkstand."
26th,	2960.	James Lysander Hale, C.E., Canton-place, Lambeth,—"Firewood."
—	2961.	George Pate Cooper, Suffolk-street, Pall-mall,—"Gorget shirt."
—	2962.	Richard Clayton, Gresham-street,—"Swimming glove."
27th,	2963.	Thomas Humphreys, Bridge-wharf, Deptford,—"American fire-lighter."
29th,	2964.	George Howe, Great Guildford-street, Southwark,—"Pressure guage."
30th,	2965.	John Johnson Broadbent and Fieldhouse Fieldhouse, Bradford,—"Tappet-lever cop motion."
Oct. 1st,	2966.	Samuel Brown, Marlborough-place, Kennington-cross,—"Economic filter."
3d,	2967.	Parr, Curtis, and Madeley, Manchester,—"Machine for straightening bars or rods of iron."
—	2968.	William Dray, London-bridge,—"Reaping Machine."
6th,	2969.	George Lomas, Addington-square, Clerkenwell,—"Spring-lever ventilator."
—	2970.	J. Levilly, George-street, Hanover-square,—"Parts of corsets or stays."
—	2971.	Edmund Youldon, Torquay,—"Portable bathing machine."
7th,	2972.	Welch and Margetson, Cheapside,—"Hat reviver."
—	2973.	Eliezer Edwards, Birmingham,—"Inkstand."
8th,	2974.	Joseph Stevenson and John Stevenson, Cripplegate-buildings,—"The soirée union back comb."
9th,	2975.	John Whitehead, Midland Junction Foundry, Leeds,—"Faller."
10th,	2976.	John Tylor and Sons, Newgate-street,—"Moderator lamp."
—	2977.	John J. Peile, Whitehaven,—"Screw-jack."
—	2978.	Miller and Sons, Piccadilly,—"Parts of a signal-lamp for railways."
13th,	2979.	John Chesterman, Sheffield,—"Double-expanding and contracting spanner."
14th,	2980.	Chadburn, Brothers, Sheffield,—"Barometer tube."
—	2981.	Edwin Rose, Manchester,—"Double-acting safety-valve."
15th,	2982.	John Symonds, (Circus), Minories,—"Gold washing machine."
—	2983.	Cartwright and Hirons, Birmingham,—"Cruet stand."
16th,	2984.	Henry Batchelor, Kennington,—"Candle shield."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 18th September, to 9th October, 1851.

Sept. 18th,	288.	Henry Maling, Home-office, Whitehall,—"Elevation sight for rifles."
—	289.	Francis Evans, Deptford,—"Music-stand."
—	290.	John N. Gibbs, Wending, Norfolk,—"Economic heating apparatus for forcing-houses, green-houses, conservatories, hot-houses," &c.
19th,	291.	Ebenezer Poulson, sen., Monkwearmouth, Sunderland,—"Life-boat."
20th,	292.	George Lomas, Camberwell,—"Spring-lever ventilator for shop plate-glass or other windows."
23d,	293.	Joshua Rhodes, Camberwell,—"Transit indicator and universal almanac."
24th,	294.	Alfred Ford, Ebury-street, Eton-square,—"Safety spring for railway carriages."
25th,	295.	A. A. De Reginald Heley, Manchester-buildings, Westminster,—"Pedestrian vade mecum."
—	296.	Richard Clayton, Cheapside,—"Sylphide waterproof gaiter."
—	297.	John E. Grisdale, Bloomsbury-street,—"Ventilating wind-guard."
—	298.	W. E. Kirkman, Knightsbridge,—"Portfolio bracket."
27th,	299.	George Gotch, Islington,—"Window flower-pot protector."
29th,	300.	William Rowden, Northampton,—"Thumb-screw lever-truss."
—	301.	Joseph William Lea, Birmingham,—"Knife-cleaner."
—	302.	Robert Watson Savage, St. James's-square,—"Invisible door-spring."
Oct. 4th,	303.	John W. Hiart, St. John's-wood,—"The couvert (chimney)."
6th,	304.	Sidney Hall, Northampton,—"Safety contraction expanding joint for railways."
8th,	305.	J. F. R. De Franclieu, South-street, Finsbury,—"Envelope letter."
—	306.	J. F. R. De Franclieu, South-street, Finsbury,—"Envelope letter."
9th,	307.	John Browne, Great Portland-street,—"Shifting paddle-wheel."

TO READERS AND CORRESPONDENTS.

Received.—"Description of the 'Moskovka' Rotatory Steam-Engine."—"The Art of Anastatic Printing."—"Report of the Glasgow Athenæum."—"Proceedings of the Glasgow Philosophical Society."—"Dynamics and Construction of Machinery," &c. By G. Finden Warr.—"The Cottage Homes of England." By J. W. Stevenson.

A. C.—We are compelled to tax A. C. with being a most inattentive reader of the *Practical Mechanic's Journal*. The peculiarities and advantages of M'Naught's Double Cylinder Expansion Engine have been explained and discussed in it at pages 35, 69, 152, and 177, Vol. I. If he will look around him in Glasgow, he will find a large number of its successful applications in the Lanarkshire district. Latterly, it has been most extensively introduced in the neighbourhood of Manchester. We are afraid our correspondent has been "dormant," for Mr. M'Naught's invention has most assuredly been "wide awake."

A Sleeper.—Kyan's process consists in soaking the timber in bichloride of mercury (corrosive sublimate.) Liebig is of opinion that the bichloride combines with the woody fibre; but others have attributed its preservative effect to the decomposition of the bichloride, in meeting with the albumen of the wood, one portion being evolved, whilst the protochloride combined with the albumen, forming an insoluble compound, and removing its tendency to decomposition. The bichloride solution penetrates to about ½ of an inch, but not so deep in fir as in some other woods. Its effect on the wood is to produce brittleness with less specific weight. The sulphate of iron of M. Breant does not alter the qualities of the timber. Sir W. Burnett's chloride of zinc has proved very effective, as well for wood as for other vegetable matters. As an instance, it has been successfully applied as a steeping solution for *cotton* sails. This application arose from the assertion, that as the *American* yacht had cotton sails, she was worked by a smaller crew, owing to the lightness of the cotton compared to linen. We believe there is something in this.

C. E.—Telford's tests of iron-wire, suspended vertically, showed results varying from 157 pounds breaking weight, for a wire of ·0479 inch diameter, to 738 pounds, with a wire of ·1000 inch,—the breaking weight in tons per square inch being, in the former case, 38·1; and, in the latter, 42. An average of six trials gave 38·4 tons. Other authorities have obtained mean results as high as from 41 to 47 tons.

DISCOVERY AND INVENTION.

II.

We will now proceed to show the ground upon which the discoverer and the inventor must stand, previously to either claiming title as such. Philosophy has not yet established a fulcrum for a lever to routine thought, and the state of philosophy (as distinct from science) in the present day is such, that the time seems very distant when such a result of philosophy may have a chance of meeting with attention. There is more science than philosophy abroad. Two great schools seem to characterise the times—namely, the one which has received the name of the sensational school, deriving its origin from a one-sided, merely physical, view of the philosophy propounded by Bacon; the other, which has yet received no specific name, but is sufficiently indicated by the idealism which characterises the writings of those who write as though they were totally unacquainted with the method of induction.. Long, we fear, will it be before these schools shall be able and willing to meet on common ground, and know the benefit resulting therefrom, which their present limited views deprive them of. Until this is accomplished, one must needs proceed in the beaten road. There are yet positions clearly discernible, which the would-be discoverer and inventor must occupy.

The precept and promise, "Seek and ye shall find," are applicable to this as to greater matters; and this precept and promise must first be borne in memory. When the mind is seeking, it is open to receive impressions, and it accordingly does, when in this state, receive them in a larger measure, than when it is not so seeking. Seeking may not, in result, if it be a new thing we are seeking, refer to the particular thing sought after, but as the original meaning of the passage shows, simply to some new truth. For our present purpose these words may be translated into others:—"Live in Nature, think with her, and her secrets will be yours." But to this end, patience, often very great patience, is necessary; in other language, a *suffering* objects and ideas to array themselves before the sight physical or mental. Any subject long contemplated must gradually unfold itself, until that sparkling moment comes when mere manly energy (the true *virtus* of antiquity) is crowned with noble knowledge. Careful observation must be our director all along, in matters equally the most minute and the most lofty. We shall have to remember that the first astronomer was he who first looked upon the sun, or the moon, or the stars, with reflection—the first palæontologist, he who first picked up a stone and observed its symmetrical form. Each, indeed, was a little thing to do, but was the germ of all that is known in those sciences. Discoveries, as inventions, can reasonably be expected only from the intelligent in the matter to which they respectively relate. The greatest discoveries and inventions must originate in the most intelligent, and their coming shines with that halo to which the name of genius is applied. There is, however, this difference between the discoverer and the inventor—the position of the latter is seldom or never affected by his invention or the thoughts leading to it; while with the former, where the discovery relates to morals, the discovery is often brought about by some conviction approaching in its violence to physical pain, and which may be enforced upon the consciousness by some private event in his individual life. It is not our present intention to touch more largely upon this, but we may remark, that the principles of the history of the mental action are as yet very obscure, however reflection must, as we doubt not, have suggested to many the incalculable discoveries which might be made by some proper investigation into them. None must be deterred by this bugbear name of genius, from prosecuting the inquiry, whatever it may be, before him. What one may do—the same *style* of thing, we mean—another may do. Momentousness must be a spur rather than a curb. But although enthusiasm always cures itself, or rather is jostled into a position to do so, there are some points to bear in mind which may save great waste of time. One of these is the order in which discoveries can be made. Thus, as regards things external, the order must run (1) individual, (2) species, (3) genus; while in things proceeding from within, the reverse of this is true; for if we attempt to discover the consequent before the antecedent, we must inevitably fail. As regards invention again, there may be called two kinds of invention, viz. (1) synthetical invention, as is that in the arts or in the science of qualities, and (2) analytical invention, as in chemistry and the science of quantities. We can leave the reader, who may need it, to work this into some form of conviction and utility in his progressing labours, and conclude this portion of our subject, by quoting from Georgiana Sand a few words, the importance of which cannot be too often insisted on. "The law of humanity is, that truth is not to be discovered by man isolated from mankind, but in the concourse of all men together." The truth to which this agreeable authoress refers, however, is not the truth to the individual, but truth to the general—not the petty truth which may really be discovered in an obscure corner, when all along it has been known and acted upon by a wide world, but the truth that is above all known truth, that stands out, as it were, from the canvas of the world, and is universally acknowledged as another step in the *right* direction.

Let us now recall to mind some of the leading principles which must go to make up that status implied in the terms discoverer and inventor. The slightest attention to the historical part of the subject tells us, that discoveries and inventions have been made, in general, by little and little. Rarely have there been great leaps. It is less favourable to ambition than to truth that this is so. And it is encouraging to the meanest to reflect, that the persons who have most benefited mankind in these things have not been those possessing golden opportunities, but simply those who, by personal industry, have collected around themselves, by hook or by crook, a larger museum of facts. One age has thus been seen to have gently progressed from another, one individual before another, one thought upon another. We see that with both the arts of discovery and invention grow, and that the first thoughts of a single person, or of a single people, are but the seeds of greater ones. These things are not given to the inactive or the weak, who always rest contented under the yoke, however burthensome—of authority, however mean.

The first principle which must suffuse the mind, is founded upon the conviction, not as some would have it, to know error to exist, but that some good as yet exists not, which it is desirable should be known. This forms the incipient mark of original thought—the foundation, concurrently with that which brings the thought into action, of the greatness, and stability in greatness, of empires. It is this thought which is so difficult to elicit, but which, by education, all civilized nations attempt to engender.

Another fundamental principle is closely allied to the one which we have just alluded to, nay, which springs from it, namely, to beware of prejudice. If, as we would, by the by, call everything by a good name, we should be inclined to say that this prejudice was a wholesome conservative power in the world. It has, undoubtedly, prevented persons, in one particular age, making all the discoveries and inventions which an aftertime has produced, and which to us, who possess them, simply affords some matter of curiosity to know how weak even the strongest of men have been. Many instances of this are on record. Huygens supplies us with a memorable one. He shared with several astronomers of his age the prejudice, that the number of satellites or secondary planets could not exceed that of the larger or primary planets; and the earth having only one satellite, he accordingly did not attempt to discover any more of the satellites of Saturn, than the largest of those now known.

A further principle not to be disregarded—nay, rather, which must be regarded with the deepest fruit-bearing attention—must now be mentioned. The illustrious author of the *Novum Organum*, after exposing to scorn

the prejudices which lay in the path of the advancement of learning, spoke as plainly on the point we now refer to as he did in all his other works. "We entertain no doubt," said he, "that any one, even of moderate abilities, yet ripened mind, who is both willing and able to lay aside his idols, and to institute his inquiries anew, and to investigate with attention, perseverance, and freedom from prejudice, the truths and computations of natural history, will of himself, by his genuine and native powers, and by his own simple anticipations, penetrate more profoundly into nature than he would be capable of doing by the most extensive course of reading, by indefinite abstract speculations, or by continual and repeated disputations, though he may not have brought the ordinary engines into action, or have adopted the prescribed formula of interpretation."* This observation, true and wonderful as it was at the time it was first made, has become a truth of wider significance at present. History has shown, by the evidence of example, that neither a scientific home, a classical and mathematical education, nor the possession of pecuniary independence, is absolutely requisite for us to use our eyes or our thoughts. Happy is it, that at all times has mankind been able, during its scientific existence, to refer to the lowly born, the irregularly educated, and the poor, as some of the greatest benefactors of the world. It would be easy to name many in the present day, at home and abroad, upon whom, in this respect, we feel assured the encomium of posterity will be bestowed. It is only necessary to have one's eyes and ears about us, for the humblest of us to do many wonders yet. This must be a faith; and as assuredly as it becomes such, so must good fruits be produced from it. There are thousands of things yet concealed from view, thousands of laws yet undiscovered, and greatly many more thousands of applications of those laws and the combination of facts, known and unknown, yet capable of invention. The discoverer and the inventor may, in this sense, be considered persons of the most exalted faith—persons unsatisfied with dry and barren knowledge, and who may eventually bring about righteous revolutions not now thought on—revolutions that, suddenly occurring, would make the best and wisest stare. The proper study of mankind is not man alone, as many constantly quote from the poet, but all things; and for this purpose, as a still greater principle to guide us, we must be at liberty to suppose everything and anything, not only things contrary to appearances, but things contrary to conviction. This, done in the pure spirit of progress, is not to launch into destroying scepticism, but to follow safely and certainly on in a faith of continuing and growing utility.

Again, we must hoard up trifles, which are as drops in the ocean of nature—the indispensable atoms making up the sum of things. We must stay with a thought or two upon this. The more of the natural philosopher the discoverer has about him, the greater field will he be capable of surveying; the more intimate he who would be an inventor is with both the works and ways of nature, the more ready access will he find to unimagined stores of new things. No tittle may be, with impunity, unheeded. It is the vulgar exclamation of every day, to wonder why such an object, or so simple a contrivance, was not found out by such or such an one, or long ago. And we must bear in mind that,

"That which before us lies in daily life,"

as Milton expresses it, is the stronghold of these trifles. It may, indeed, be more difficult to pry into such matters, which, by a kind of sense-attrition, are rounded to perfect form. The stimulus of curiosity meets us not at the threshold. How wisely did Mrs. Hemans say—

"There lies deep meaning oft in childish play!"

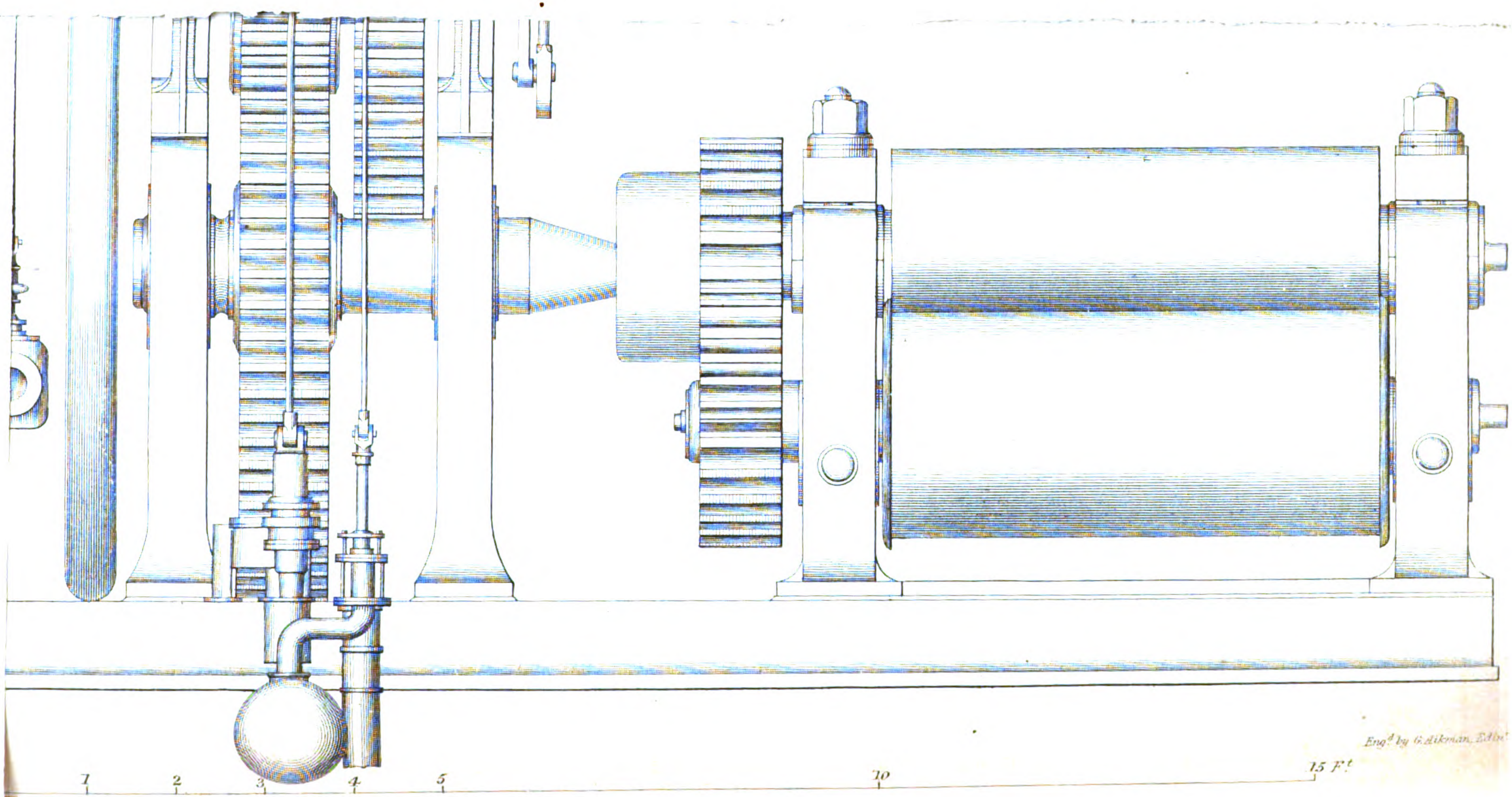
And how justly may we extend the truth conveyed! Copernicus somewhere assures us, that one of the first things that contributed to the evolution of his true theory of the planetary system, was the effect produced by the motion of a spectator in transferring that motion to the objects observed, but ascribing to it an opposite direction. An apple afterwards falling to the earth, led Newton to prove the Copernican system to be correct. The spinning of a common top involves the most difficult conditions in dynamics, and also serves to explain all the intricacies of the planetary vertiginous motions. We have heard, in our own day, how observation of the minute disturbances in the course of the planet Saturn ended in the wondrous discovery of Neptune. And it is ever thus in other things. As a pebble dropped from the hand alters the centre of gravity of the whole of matter affected by its laws, so may the observation of what is called a trifle serve to enlarge even the very bounds of humanity, like that 0 in figures—a thing of no value by itself—but nought as it is, becomes important from association. It is in the experience of most of us, how trivial events have led to some of our happiest as well as to some of our most unhappy moments. The turning up one street instead of another has, in an instance within our own knowledge, shaped the course of a whole prosperous and honourable life. The small quantity of water produced by the experiment of the union of oxygen and hydrogen had been at first quite overlooked, although, as it now appears, this water offered the key, as Mr. Whewell observes, to the whole interpretation of the change of those two gases into what has been considered their compound. In magnetic observations, the astronomer-royal has declared that great importance is due to small disturbances, and every other department of science confirms such report of trifles or small things. It is not likely that this general truth should entirely have escaped even everyday people. "The mother of mischief," says the Scotch proverb, "is no bigger than a midge's wing." And long long ago did the Latin poet hand down to posterity one of the tenets of his Epicurean teachers, that Nature works in leasts. Even the poet himself is affected by the potenz of littles. Few people can realize, said Goëthe, that he is prompted to his highest efforts by slight occasions. One of the more popular verse-writers of the present day has alluded to this—

"The world, in its boyhood, was credulous, and dreaded the vengeance of the stars;
The world, in its dotage, is not wiser, fearing not the influence of small things."

The wonderful mind of the busy Chancellor of England, whose labours toward the reform of his court-practice have been so signally eclipsed by what he did for all learning, may be said to have existed in trifles. Every natural act—he repeats over and over again—in substance, is brought about by the smallest efforts. Nor can this excite surprise when we know how "the power of littles," as Dr. Chalmers somewhere called it, actuates the most deep-thinking and wonder-working minds of the present century. The truth seems to be, that the most subtle mind that can best appreciate little things is known to itself to be but as a different kind of microscope, for it is conscious, from experience, that the more minute particular observations are, the greater freedom from error must attach to general conclusions and laws relating to natural phenomena. Our "lawyers," indeed, have a maxim, *De minimis non curat lex;* but this, it is very well known, is intended and acted upon as a hole for natural equity to creep out of, rather than to give out to the world that they are not cognizant of trifles, which, in many matters, have, we well know, served to divide justly innocence from crime, and right from wrong.

Neither the discoverer nor inventor, however, must dwell alone in so minute a field. He must occupy another concurrent position, if we may use the term. The great namesake of the instaurator of the sciences, Roger Bacon, ages ago, told the world what this was. There are two methods of acquiring knowledge—the ideal path, and the path of experiment. It is observable that he places the ideal mode first, whether from the prejudice of his times, or from deep insight, it is unnecessary to inquire. There is too little of this mode at present, as there was too much of it before the age of Verulam. It had then, indeed, entirely usurped the place of experiment, as experiment in these times seems to be encroaching on the labours of her sister work-fellow. On principle, the discoverer must, therefore, bear this in mind, and know that discovery is not, and never can be, perfected for any benefit beyond getting through

* Nov. Org. 5th part.


Eng^d by G. Aikman, Edin^r
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a dull hour, until it is elaborated into some great fact, or law of fact, which may readily catch hold of the general mind. We must be open to theorise, to compare accurately our theories with our facts, and boldly to judge and speak out from the judgment-seat. When an apparent law opposes an apparent law, there is reason to suspect error in both. Thus Dollond thought when he had, from an experiment made by Newton, deduced a law with regard to the relation between the refractive and dispersive powers of light; and when this deduction was combated by Eüler, and afterwards by Klingenstierna, the Swedish mathematician, Dollond never rested satisfied until he had, from experiment, refuted not only the law he had thus deduced, but also that which had been propounded by his opponent, and established the point that refraction was altogether independent of dispersion. In acting thus, we, in fact, act merely in a strictly logical manner. We take all that is known —general and particular — work out a more general, comprising all generals, and are careful that no one particular is in opposition. The really scientific mind of Burke, the statesman and theorist, occasionally blurted out the law regulating those things that cannot stand without theorising. He says, in his preface to the essay on the Sublime and Beautiful—" The characters of nature are legible, it is true, but they are not plain enough to enable those who run to read them. We must make use of a cautious, I had almost said a timorous, method of proceeding. We must not attempt to fly, when we can scarcely pretend to creep. In considering any complex matter, we ought to examine every distinct ingredient in the composition one by one, and reduce everything to the utmost simplicity, since the condition of our nature binds us to a strict law and very narrow limits. We ought afterwards to re-examine the principles by the effect of the composition, as well as the composition by that of the principles. We ought to compare our subjects with things of a peculiar nature, and even with things of a contrary nature; for discoveries may be, and often are, made by the contrast, which would escape us on the single view. The greater number of the comparisons we make, the more general and the more certain our knowledge is likely to prove, as built upon a more extensive and perfect induction." It was in this manner that Burke's theory on the subject then before him, and for which he is now alone rememberable, was elaborated; and it is in this manner that science and philosophy must progress. Theory must ever be the constant attendant upon discovery of facts, whether facts of minute or of enlarged interest.

Another principle, not to be forgotten, is to take care that, when facts are obtained, we hold them fast. The habit of making written minutes of our discoveries and inventions, however apparently trifling they may be, is an important one. We can, of course, know the value of this only by personal experience; but we divine it must be a part and parcel of every great discoverer and inventor, who best knows how more clearly he can detail it to others, immediately a fact is made known to himself, than after a time when it becomes blended with his general knowledge; and the best attempted description partakes, unconsciously, of that general knowledge. It is recorded that when Dr. Matthew Stewart discovered any proposition, he would put down the enunciation with great accuracy, and on the same piece of paper would construct very neatly the figure to which it referred. To these he trusted for recalling to his mind, at any future period, the demonstration or the analysis, however complicated it might be. Experience had taught him that he might place this confidence in himself, without any danger of disappointment. It will be, of course, right to review the observations thus recorded from time to time, and often we may find that, in this effort to detect error, we may be led to the discovery of new truth, or to the invention of new forms.

In noticing the principles upon which it is absolutely necessary the discoverer and inventor should stand, it must not be thought that we have exhausted all that might be said, or shown all their forms. Each of these benefactors of mankind, no doubt, establishes many others; and some of the greatest we know have manfully stood upon another which must not be omitted to be noticed in this place, although there is so much to be said about it that we must reserve it to be treated more at large, at another opportunity. We mean, the making a thorough stand against all opposition. Galileo may be said almost to have effected, by this means, the revolution of the earth on its axis; that, by this means, Harvey made the blood to circulate in all blood-bearing animals; and that, by this means, Newton overcame the Cartesians and the falsities they would have had the world believe. There are many matters, in the present day, to which this *stand* is applicable. Even ballooning may be one. Its results, when it shall have passed from an amusement into the arena of science, who may conjecture! We have faith that it must produce *some* benefit, although it may be distant, or lead to some discoveries not yet, perhaps, even imagined by fancy. Let us draw the attention of those who think otherwise, again, to another most true remark of the great thinker:—" We may also derive some reason to hope," says he, in the expression of his intense desire to make some few others think with him in his grand new style of thought, " from the circumstance of several actual inventions" (including, as he often does in that term, what we would designate discoveries) " being of such a nature, that scarcely any one could have formed a conjecture about them previous to their discovery, but would rather have ridiculed them as impossible. For men are wont to guess about new subjects from those they are already acquainted with, and the hasty and vitiated fancies they have thence formed." *

MESSRS. ROBINSONS AND RUSSELL'S EXHIBITION SUGAR-MILL.

(*Illustrated by Plates* 84 *and* 85.)

Our October part contained a plate of two views of this specimen of the mechanism of the sugar manufacture, and we now give, in plate 85, a complete side elevation of the entire mill. This mill is one of the latest of the kind, made according to Messrs. Robinsons and Russell's patent for the combination of the mill and engine on one bed plate, and presents several very important improvements in the construction and arrangement of sugar machinery. After many years' experience, the makers have found that an excessively large item in the expenses of the process of sugar-making, arises from the first cost of erection of the mill-work —the wear and tear of the machinery, arising either from insufficient foundations, or their unequal settling, and the severe strains thus thrown upon the different parts, often twisting the shafts, and stripping the teeth of the wheels. To the planter, very serious difficulties were presented in the shape of enormous outlay for making the costly foundations necessary for the prevention of greater evils. To obviate these inconveniences and defects of the common form of mill, Messrs. Robinsons and Russell took out their patent for the combination of mill and engine on one bed plate, so that all strains are within the machine itself, and any unequal settling of the ground has no effect in deranging the action of the whole, or preventing an easy adjustment of its parts; and the entire machine being fitted at the manufactory on its foundations, the re-erection abroad is performed with great facility.

The D size, Exhibition Mill, from which our drawings have been taken, has attracted considerable attention from its great size and novel arrangements. In it, the makers have taken advantage of the simplicity of construction, and easy adaptation of the oscillating engine, and have combined it with their mill, as well for economy of space and saving of weight, as for an easy adjustment of its details. The whole mechanism stands on a single base plate, which carries five standards—three tall ones to carry the engine, crank-shaft, and gearing, and two short ones for the expressing rollers. The oscillating cylinder is suspended by its trunnions on one side, upon a bearing in a low outside pillar, and on the other, on a bearing carried on a cross bar near the bottom of one of the main engine standards; motion is communicated from the crank-shaft through a spur pinion, keyed on the opposite extremity of the shaft, and gearing with a spur wheel on a shaft set in bearings on the upper corners of two of the engine standards. This shaft, again, carries a second spur pinion in gear with the large wheel on the main driving-shaft,

* Nov. Org. Aph. 109.

the end of which is connected by a conical coupling with the first of a set of three pinions for actuating the three rollers. The engine is arranged to work expansively, with a simple adjusting apparatus, and is calculated to make 42 revolutions per minute—the quantity of juice produced by the mill, from canes of average quality, being 3,000 gallons per hour.

HASTIE'S SEMI-GRAVITATING STEAM-ENGINE.*

Fig. 1.

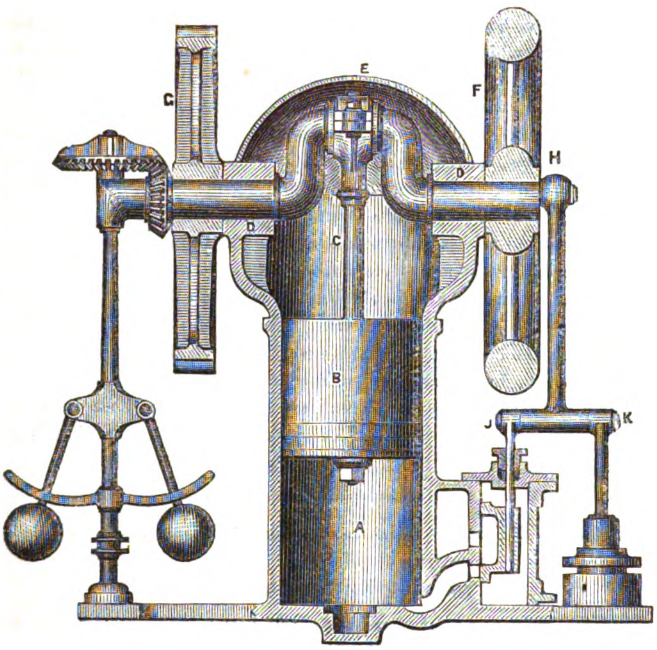
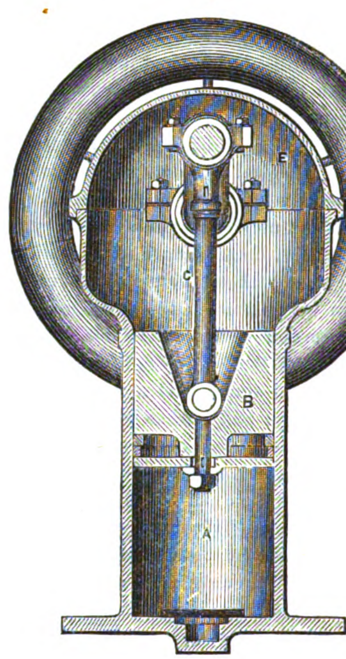


Fig. 2.



1-16th.

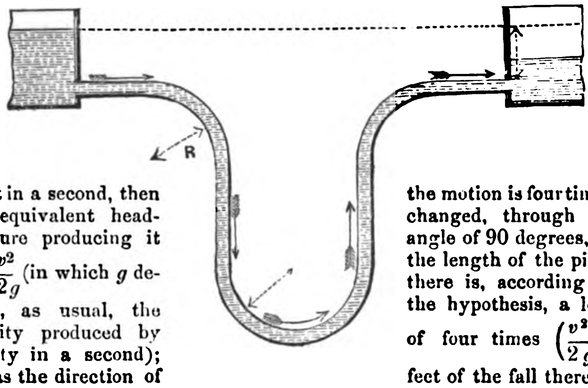
The modern tendency towards the introduction of steam power for agricultural works, and isolated applications of a similar nature, where a moderate power only is required, has latterly stimulated engine-builders to attempt the production of cheap, simple, and substantial engines, which, whilst they work in a satisfactory and economical manner, may yet, in first cost, come within the means of the farmer and small manufacturer. Just such a cheap and useful machine has recently been introduced by Mr. John Hastie, now of the firm of Hastie and Weir of Greenock, and formerly the superintendent of Messrs. Scott and Sinclair's extensive marine-engine works in the same town. Of this arrangement, our engravings present two complete views. Fig. 1 is a longitudinal sectional elevation, taken in the line of the crank-shaft; and fig. 2 is a vertical section at right angles to fig. 1, through the steam-cylinder and cover, with the fly-wheel in elevation behind.

The engine is on the single-action atmospheric plan, the cylinder, A, being open-topped, and cast with an expanded upper end. The piston, B, is cast with a considerable weight on its upper side, for the purpose of acting as a counterweight during the down stroke, when the steam is exhausting from the bottom of the cylinder. A conical or taper hole is cast in the centre of the weight on its upper side; and through the bottom of this hole a bolt is passed, having an eye at its upper end for connection with the lower end of the direct-action rod, C, which here, of course, acts both as piston and connecting-rod, just as in Humphrey's and Penn's trunk engines. The overhead crank-shaft is carried in two end-bearings, D, in opposite sides of the expanded cylinder top, which is closed in, so as to cover up the crank, and the space above the piston, by the hemispherical lid, E. One end of the crank-shaft carries the fly-wheel, F, and the weight of this is balanced on the opposite end of the shaft by the spur driving-wheel, G. The single-port slide for admitting steam beneath the piston is at the side of the cylinder, near the bottom, and is worked in the simplest possible manner by a short crank-pin, H, on the fly-wheel, or the crank-shaft end. From this pin a short valve-rod passes downwards, terminating in a T end. One projection, J, of this cross-tail serves to work the valve-spindle, whilst the opposite one, K, similarly actuates the cold-water pump. The governor is at the opposite side of the cylinder, being driven by a pair of small bevel-wheels from the end of the crank-shaft. Our drawings are made from a six-horse engine, erected in the island of Islay, to drive a thrashing-mill. The cylinder is 12 inches diameter, having a piston 12 inches deep; and the steam pressure used for it is 25 or 30 lbs., the speed being 110 revolutions per minute. The weight of the piston and connecting-rod is 3 cwt., that of the fly-wheel 10 cwt. Mr. Hastie calculates its cost in fuel at 1½d. per hour, whilst its first intrinsic cost is one-third less than that of a common engine. To many of the readers of this *Journal*, Mr. Hastie's name will be well known, as well in connection with many valuable improvements in tools, as being the inventor of the system of actuating grinding-mills by a single engine to each pair of stones, noticed some time back in our pages. His present contrivance has the extreme merit of great simplicity and easiness of management, whilst it presents a symmetrical appearance, and works with great regularity, the counterweight being so arranged as to produce the effect necessary to keep up a uniform movement during the time the steam is shut off from the cylinder. It promises to be a most useful assistant in the operations of the farmer.

A SMALL QUESTION IN HYDRAULICS.

I was lately placed in rather an awkward position in giving evidence on a particular mode of applying a water power, by the counsel in the interest for which I was called, insisting on an unqualified admission that a loss of fall is incurred by taking the water through an inverted syphon-pipe to the wheel. I was, of course, ready enough to admit that the increased length of pipe causes additional frictional resistance to the passage of the water, and that a further loss of head-pressure, sometimes considerable, is incurred by the bends of the pipe, as these interrupt the parallelism of the lines of unequal velocity of the fluid, and to some extent disturb the law of continuity. For both of those influences, tables have been calculated from experimental data, embracing almost every supposable case. But this admission was not reckoned sufficient by the learned gentleman: he would have it that, over and above, and, if I mistake not, independently of those losses, there is a loss of head-pressure incurred equal to that represented by the velocity which the water possesses before the direction of its motion is changed. Thus supposing that the pipe has the form here

depicted, and is of the same bore throughout its length; if the mean velocity of the water in the directions indicated by the arrows is =



v feet in a second, then the equivalent head-pressure producing it is $= \frac{v^2}{2g}$ (in which g denotes, as usual, the velocity produced by gravity in a second); and as the direction of the motion is four times changed, through an angle of 90 degrees, in the length of the pipe, there is, according to the hypothesis, a loss of four times $\left(\frac{v^2}{2g}\right)$ feet of the fall thereby incurred; and the head-pressure necessary to produce the velocity, v, at the exit-end of the pipe, is consequently not less than $\left(5 \cdot \frac{v^2}{2g}\right)$ feet.

That this doctrine is contrary alike to experience and to all established theory, is sufficiently obvious to every person who has given any systematic attention whatever to the first principles of hydrodynamics; still it is worth devoting a little consideration to the particular case, if only for the purpose of preventing the recurrence of such another untoward discussion as that to which reference has been made.

The fact of experience is, that the amount of loss depends on the character of the bends by which the direction of the motion is changed. When knee-bends are employed, the loss of head is considerably greater than it is with rounded bends: it approaches then very nearly to the learned gentleman's hypothesis of a total destruction of a head-pressure, equal to that represented by the velocity of the water in the pipe. For a rectangular knee-bend, the loss, according to Weisbach's formula, amounts to $\left\{ 0{\cdot}9846 \frac{v^2}{2g} \right\}$ feet. But nobody employs such bends where it is important to economise the fall; and for rounded bends, the loss, although it still increases as the square of the velocity, is reducible at pleasure, by simply increasing the radius of curvature of the bends. The general expression, according to the authority quoted, is $\left(\kappa \frac{v^2}{2g}\right)$ feet, and the value of the coefficient depends on the ratio, $\frac{r}{R}$, of the radius, r, of the pipe, to the radius, R, of curvature of the axis of the bend. For a change of direction = 90 degrees, we have

$$\kappa = \left\{ 0{\cdot}131 + 1{\cdot}847 \left(\frac{r}{R}\right)^{\frac{7}{2}} \right\} \cdot \frac{90^\circ}{180^\circ}.$$

And supposing that we assume $R = 5r$, which is quite a sharp enough bend, this coefficient is $= 0{\cdot}069$; and the loss of head-pressure for a change of direction of 90 degrees is therefore less than 7-100ths of that represented by the velocity of the water in the pipe. For four such changes of direction, it is consequently little more than a fourth of the head due to that velocity; and the whole pressure employed in producing the velocity of v feet per second in the supposed pipe, neglecting the simple frictional resistance due to the length of the pipe, as if it were straight, is therefore only $\left(1{\cdot}276 \frac{v^2}{2g}\right)$ feet, and not $\left(5 \cdot \frac{v^2}{2g}\right)$ feet, as the new hypothesis would make it.

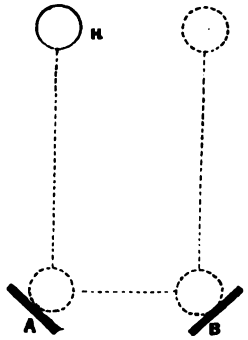
For illustration, let it be supposed that the pipe is 42 inches inside diameter, and that it is delivering 40 cubic feet of water per second. The mean velocity, v, is in that case = 4·158 feet, and the head-pressure due to it is = 0·268 feet. In addition to this, there is the head-pressure expended at the four bends = (·268 × ·276 = 0·074) feet. The total head-pressure employed in bringing forward this quantity of water in the pipe (neglecting the equivalent of the simple friction) is therefore no more than 0·342 feet—a little more than 4 inches; whereas the new hypothesis would make it at least 1·34 feet, or fully 16 inches.

It has already been remarked, that the co-efficient, κ, may generally be made very small, as the radius, R, of curvature of the bend may be made almost as great as we please, in comparison with r, the radius of the bore of the pipe. But, according to the new-found doctrine, the amount of head-pressure destroyed is independent of the kind of bend employed, and is determined by the angle of deviation, simply and directly. When the direction of the motion is changed through an angle of 90 degrees, the loss is *unity;* less when the angle is less, and greater when the angle is greater, and in the same proportion. This at least is my present interpretation of the arguments employed by the learned gentleman; and it is certainly not surcharged, for it is, moreover, strongly impressed on my recollection, that the supposed loss of head-pressure, from merely changing the direction of the motion, was regarded by him as additional to that arising from the presence of those influences usually contemplated in questions of this sort.

Be that as it may, the hypothesis, according to either interpretation, is equally opposed to the facts of experimental investigation, and experiment must always be our *dernier ressort* in those cases which do not admit of an exact appreciation of all the individual circumstances which influence the result. We are then content to accept an expression of their sum; and experiment is nothing more than a practical mode of integration. In such cases, the formulæ derived are not intended nor pretended to express the true or absolute laws of the phenomena; on the contrary, they are merely empirical expressions constructed to represent the continuity of those phenomena within the limits of the data. The formulæ connecting the elasticity of saturated steam with its temperature are all of this kind; nobody supposes them absolute, and yet the most defective of them are reckoned sufficiently accurate for most ordinary calculations which fall within the portions of the scale of temperature to which they are intended to apply. It is merely the same with the formulæ of hydraulics; none of them are absolute expressions of the law which they partially represent, and, like other partial integrals, they are assumed to apply only within the experimental range. I have here employed Weisbach's formula for the effect of bends in water-mains, chiefly because it is among the simplest of those published, and it is derived from a very extensive and very carefully-conducted class of experiments with pipes of considerable size. I might, however, have adopted the equivalent formula from Dubuat, Eytelwein, Navier, Prony, Poncelet, or somebody else—any one of them would have served my present purpose equally well, provided the author is recognised as good authority; and had the question been one of practice, and in which a responsibility devolved, and especially if the pipe were of very large diameter, the formula employed would have differed in some particulars, and slightly in its result, from any published form that has happened to come under my notice.

It is not necessary to carry the hypothesis beyond the point at which we left it above; more time, indeed, has already been expended upon it, than my very recondite friend would be likely to give to the opinion of a non-professional dabbler in legal quiddities; yet I have never heard that the Commentaries of Blackstone are more profound, or require the application of a higher order of mind, than the Principia of Newton. After appealing to experimental conclusions, there is, moreover, no necessity to have recourse to ratiocination. Facts are the most convincing logic. I have said nothing in refutation of the fundamental error on which the hypothesis is built, simply because it is now too late, in the world's progress, to believe that any person, whose opinion has the slightest claim to consideration, will seriously argue that the direction in which a body is moving cannot be changed through an angle of 90 degrees, without destroying the entire moving force it possesses. Such a proposition is contradicted by all the established laws of mechanics; and it is far more obviously untrue when transferred to the region of pure dynamics, in which frictions, vibrations, and other passive resistances have no place. The question then becomes the following:—A body, moving in a given rectilinear path, has its motion directed into a path perpendicular to the first; can the force producing the velocity which the body possesses in the first direction, pass over with the body, and maintain the velocity in the new direction? The whole code of celestial mechanics illustrates the affirmative, and terrestrial mechanics—far more complex, because involving many more modifying influences, and the entire doctrine, indeed, of the application of moving forces by machinery—testify that the same law prevails on earth as among the worlds of space. If a perfectly elastic ball—and one of ivory or glass nearly answers the condition—is projected against a perpendicular surface of like quality, it rebounds, and, by hypothesis, brings back with it the entire quantity of movement originally communicated to it. In actual experiment, the momentum is lessened by the amount of work taken up by the imperfect elasticity of the ball, and of the surface on which it is projected, the resistance of the air, and other influences, which we cannot eliminate, but which we may appreciate with tolerable accuracy. In this case, the direction of the motion is changed through an angle of 180 degrees; but if the reflecting surface forms, with the path of projection, an angle of 45°, the ball is then deflected into a path perpendicular to the direction in which the force is primarily applied. The conclusion is therefore manifest. A body moving in a given direction, in virtue of a pressure

applied to it in that direction, may have the line of its path changed through any angle without destruction—I might say, without diminution—of its momentum. Suppose that the ball is allowed to fall from a height, H, upon the surface of the reflector, A, placed at an angle of 45° with the plane of the horizon; the velocity with which it is moving, at the instant of impact, is $=\sqrt{2g}$ H; and the working power accumulated in it is = (weight) H. This power must be given out in some way before the ball can come to rest. Now, in striking against the surface, A, the ball is simply deflected horizontally; in this there is no work done, no resistance overcome, no weight has been lifted, and weight lifted is the direct synonym of mechanical work, whatever may be the guise it assumes. The ball then passing from the surface, A, impinges on the similar surface, B, placed at the same angle with the horizontal plane, and therefore with the line of the path into which the ball is deflected by A: meeting this second surface a second change of its direction is produced; but the direction is now vertical, and the ball begins that instant to do work—namely, to raise its own weight through a height, H, equal to the height from which it was originally let fall.



In these cases no new force acts on the body when its direction is changed; the reflecting surface merely offers resistance to the continuance of the motion in a particular direction, and the ball itself is not supposed to have any capacity for generating momentum. The experiments are, besides, not supposititious; they have been repeated and verified in a thousand ways. The last closely represents the case in point; for as the reflectors are neither perfectly elastic nor perfectly hard, and the ball is neither perfectly elastic nor perfectly uniform, some part of the height, H, from which it is let fall is thereby lost; the ball will not ascend to exactly the same height, H, by some fraction, more or less considerable, according to the nature of the materials employed. A lead-ball will scarcely rise to any appreciable height; all the accumulated work in it is expended in merely altering the form of the material. A soft clay-ball affords a still more complete illustration of this mode of expending the work of the fall.

It is in cases analogous to this that power is often said to be *lost* in transmission from one point to another. Mechanics, however, presents no example of loss in the absolute sense of the term; and when power is said to be lost, nothing more is or ought to be meant, than that the whole equivalent of work is not realized in the desired form; that a portion of it has been taken up by friction and vibration in the case of solids, and by disturbance of continuity in that of fluids, elastic as well as non-elastic. Or, generally, the power not represented by the available work must be looked for in the quantities of molecular motion which have been excited and destroyed in the moving masses. We have often, indeed, the whole power thus internally taken up, for molecular agitation is often the entire work to be done—*e. g.* in the pug-mill, the churn, and, strictly speaking, in all processes of grinding.

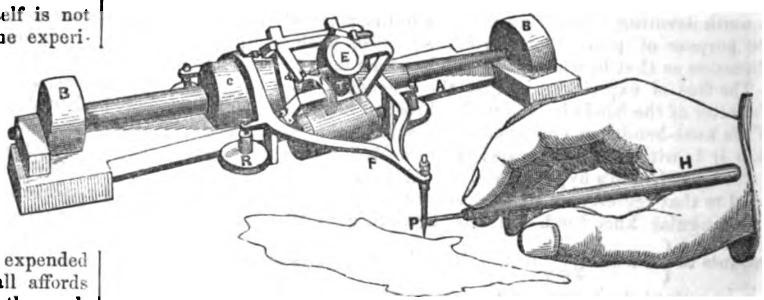
In fact, and in conclusion, the discoverable law of this world—nay, of the universe, as far as the telescope has yet pierced into space—is, that every cause shall produce its measure of effect whenever and however it operates; and correlatively, that no effect shall fall short of, or exceed, the operative agency by which it is produced. And those terms—cause and effect—translated into the language of mechanics, are power accumulated, and work done.

β.

SANG'S PLATOMETER, OR SELF-ACTING CALCULATOR OF SURFACE.

The usual method of discovering the area of a figure drawn on a plan, is to divide it into a number of triangles or trapeziums—to measure the base and altitude of each, and take the sum of their products. By a careful process of this kind, the area may be discovered with great accuracy; but as it is necessary to revise the calculations several times, both for the purpose of obviating faults in the arithmetical part of the work, and in order, by taking the average of a few independent measurements, to increase the probable accuracy of the result, this method of calculation, especially when the figure is irregular, entails a considerable amount of labour of an irksome kind. Attempts have been made to avoid this by cutting the figure from the sheet of paper, and weighing it in a delicate balance against weights consisting of parts of the same paper, of determinate sizes; but this method—at first sight simple and practical—is rendered of little use by the impossibility of obtaining paper of uniform thickness throughout the sheet, the variation of thickness—and hence of weight—being greater than the amount of error that could be allowed in the results.

The instrument invented by Mr. Sang of Kirkcaldy, represented in our perspective figure, indicates the area of any figure, however irregular, on merely carrying the point of a tracer round its boundary, and, besides the advantage of not injuring the drawing, it possesses that of speed and accuracy. A frame, A, carries an axle, which has on it two rollers, B, of equal size, and a cone, C. It is heavy, so that it maintains its parallelism on being pushed along the paper. The sides of the frame are parallel to the edge of the cone, and are fitted to receive the circumference of four friction rollers, R, which move along A, and carry a light frame, F, terminating on the tracing-point, P, to which the handle, H, is attached by a universal joint. The frame, F, also carries a wheel, I, which, by means of a weight, is pressed on the surface of the cone, and receives motion from it as the tracer is carried along the paper. The index-wheel, I, only touches the cone by a narrow edge, the rest of its circumference being of smaller diameter, and containing a silver ring divided into 200 parts, which are again subdivided by a vernier into 2,000 parts. The value of each of these divisions is the $\frac{1}{100}$th part of a square inch; so that one turn of the wheel represents 20 inches. Another index-wheel, T, moved by I, is divided into five parts, each of which represents 20 inches, so that a complete revolution of T values 100 inches.



The eye-glass, E, assists in reading the divisions and vernier.

It is apparent, from the construction of this instrument, that if the tracer be moved forward, it will cause the index to revolve, not simply in proportion to that motion, but in proportion to the motion of the tracer multiplied by the distance of the edge of the index-wheel from the apex of the cone; and that the revolving motion of the index-wheel will be positive or negative, according as the tracer is carried backwards or forwards. Hence, if the tracer be carried completely round the outline of any figure—on arriving at the end of its journey, the index-wheel will show the algebraic sum of the breadth of the figure at every point, multiplied by the increment of the distance of the points from the apex of the cone; that is to say, the area of the figure.

This instrument possesses great simplicity of construction. Both factors of the continuous multiplication are directly transmitted from the motion of the tracing point in the simplest manner. The influence of the elasticity of the parts of the machine on the accuracy of its indications, may be discovered by moving the tracer a second time over the boundary of the figure, after having turned the whole instrument round 180°. The effects of the imperfections in the mechanism will now have changed signs, and one of the results will probably be found to be a little too large, and the other a little too small. The average between the two is the exact area of the figure, and is more to be depended on than the results of measurements made by scale and calculation in the usual way. A careful operator, in using the platometer, will always take the average of two tracings in this manner; but when he experiences the rapidity with which this may be done, he will find the trouble as nothing in comparison with the harassing labour of calculating by scale and multiplication.

RANDELL AND SAUNDERS' BRICK, TILE, AND PIPE MACHINE.

(Illustrated by Plate 86.)

Amongst the more important machines for the manufacture of plastic materials, shown in the Great Exhibition, we have to notice a series exhibited by Messrs. Randell & Saunders of Orange Grove, Bath, in

Plate 86.

Vol. IV.

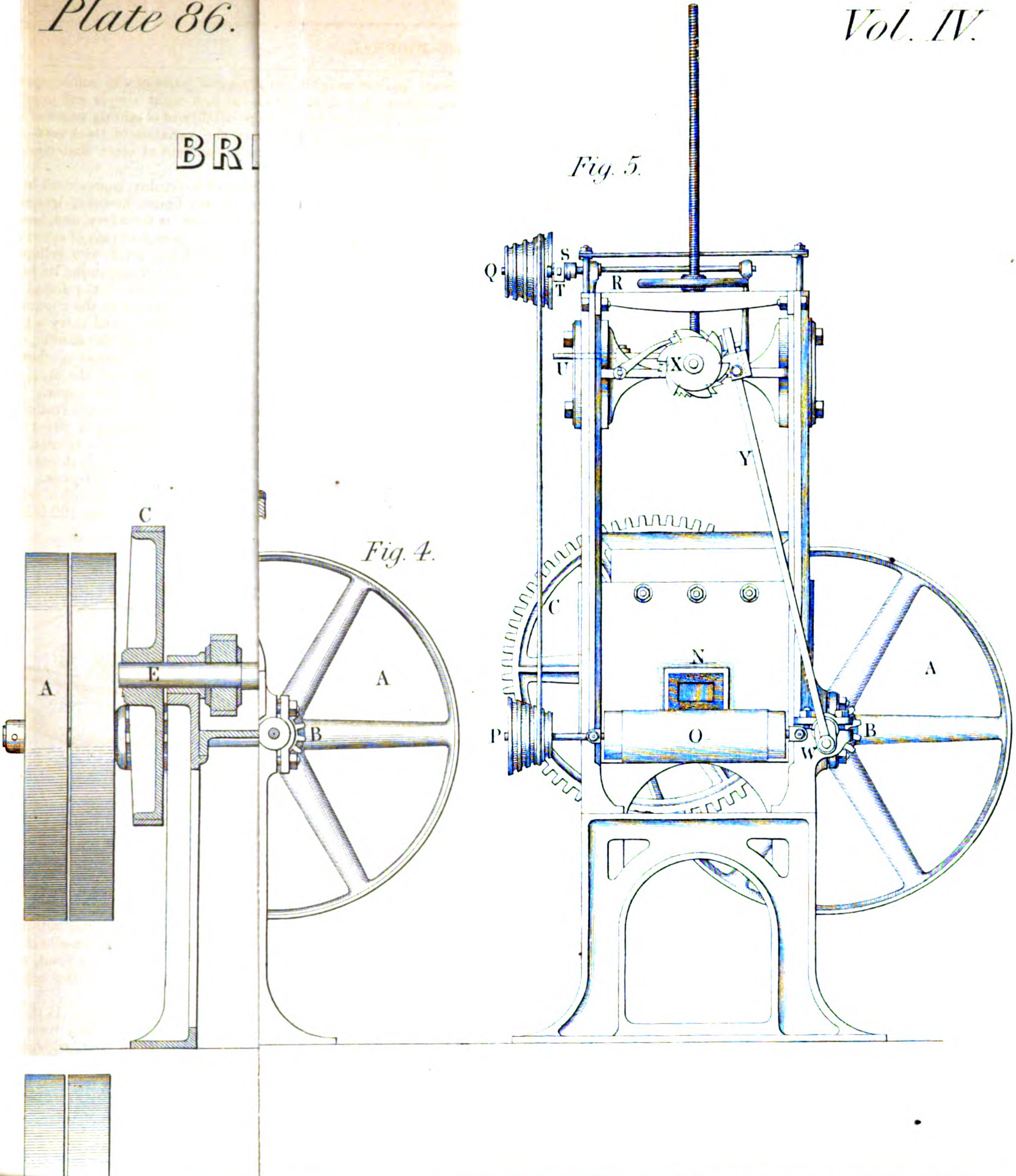


Fig. 4.

Fig. 5.

Class 9—"Agricultural and Horticultural Machines and Implements." Of this collection we have selected their "Brick and Tile Screw Press, with perpetual Cutter," as the subject for our plate 86, which contains five several views of the machine and its details.

Fig. 1 is a longitudinal elevation of the machine, partly in section, to show the screw action in the clay cylinder. Fig. 2 is a plan corresponding, in its complete state. Fig. 3 is a front elevation of the perpetual cutting apparatus detached. Fig. 4 is a transverse vertical section of the clay cylinder, with the driving gear and framing; and fig. 5 is a complete external front elevation of the machine, looking on the moulding die.

In this machine are secured the two important objects of—a press which forces the clay through a die without cessation, as long as it is supplied to the machine; and a perpetual self-acting cutter, which severs the clay without any interference with its progress. The power is applied to the machine through the fast-and-loose pulley arrangement, A, on a horizontal shaft, carrying a spur pinion, B, in gear with a larger wheel, C, the pinion-shaft being prolonged inwards along the side of the machine, as at D, to the opposite end, to actuate the cutting apparatus. The wheel, C, is fast on the long horizontal shaft, E, on which is a pinion, F, gearing with a corresponding pinion, G, on a second parallel shaft, H. These shafts each carry a clay-traversing screw, J, the deep threads of which are cast or formed on hollow spindles entered upon the driving-shafts, which latter are carried at their opposite ends in bearings fixed in the interior of the clay cylinder at K. The screws are right and left, and are so set that their threads—which are made very deep—shall fit or gear into each other as delineated in the plan, fig. 2, the thread or coil of each penetrating nearly up to the spindle of the opposite one. The clay-chamber, L, into the interior of which the screw-threads fit closely, may be called a duplex cylinder, being composed of two cylindrical portions cast together, with a corresponding cover bolted along the upper side. The clay is thrown into the fixed hopper or receiver, M, from which it passes downwards through an opening in the upper side of the chamber beneath, and is pressed forward along the cylinder by the combined action of the right and left screws, until it emerges in a continuous stream at the mouth-piece, N, formed so as to mould the clay to the required section of the brick. The bricks so made, with a plain open mouth, are of course the ordinary rectangular solid bricks; but when fitted with a central core, as in the plate before us, hollow bricks are produced of the section shown in fig. 5. As the stream of clay emerges from the die, it passes over an endless cloth on the rollers, O, which revolve by the action of the clay itself, and their motion is taken advantage of for governing the cutting mechanism by the cone pulley, P, on the spindle of the first of the series. From this cone a crossed endless cord passes upwards to a corresponding pulley, Q, overhead, which is carried on the end of a short horizontal shaft, R, carrying a lever, S, for an intermittent elevation of the hammer, T, hinged loosely on the same shaft. When the elevating lever passes, this hammer falls, and striking the end of a lever, U, it releases the spring cylinder, V. This cylinder contains a coiled spring, which is kept constantly wound up by the action of the crank-lever, W, on the end of the prolongation of the first motion-shaft, D, through the intervention of the ratchet-wheel, X, worked by a catch on the upper end of the connecting-rod, Y. The cutting wire is shown at Z, in fig. 3, attached to its vertical guide-frame. When the spring cylinder is released, it flies half round, and its lever, *a*, and connecting-rod, *b*, then cause the cutting wire to descend, severing the required portion of the clay as it issues, pugged and moulded, from the cylinder. The actuating ratchet-wheel, X, may be divided into any required number of parts, one of which must be longer than the rest; and the rod, Y, acts upon it to wind up the spring, until the long reach or division is presented, and over this division the catch will not pass. The ratchet-wheel and spring, which are connected to the same shaft, therefore wait until the cylinder, V, has made a revolution; in doing which, by means of a lug, *c*, it knocks forward an arm, *d*, also on the same shaft as the ratchet-wheel. By this means the ratchet is knocked forward, and the lever passes over the long reach, and puts the ratchet, X, in motion as before. By shifting the cord on the cone pulleys, the moulded clay may, of course, be cut into various lengths.

When it is intended to give the ends of the moulded articles a corrugated shape, a corrugated knife is attached to the spring cylinder, and this knife, revolving with the cylinder, is pressed through the clay, giving the corrugated form intended. The machine is thus entirely self-acting, the attendants having nothing to do but supply the clay, and remove the manufactured articles.

When worked with a power of two horses, the machine produces 1,000 bricks, or 1,800 two-inch pipes per hour. If it should be necessary to pass the clay through rollers for the purpose of crushing it, the rollers may be placed over the hopper of the machine, so as to deliver the crushed clay into it.

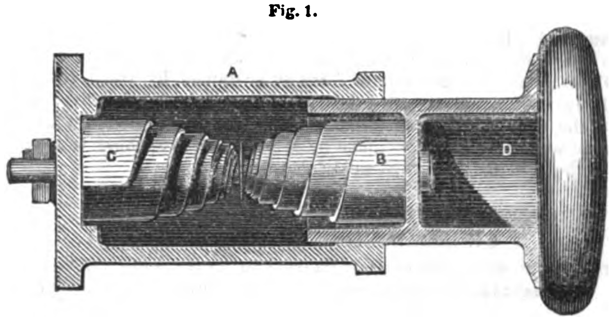
The clay is pressed without taking in any air with it, and thus the ware comes out free from the bubbles so often seen in the ware produced by piston presses. The moderate cost of a machine of this kind places it within the reach of nearly all who are concerned in this branch of manufacture, both as regards original outlay and expense of management. Whilst it lessens the amount of labour involved in brick-making, the clay being used in a much drier state than when moulded by hand, it leaves less to be done in drying; and when hollow bricks are made, a material saving is effected in the cost of burning.

Messrs. Randell & Saunders are also the inventors of several machines for sawing and quarrying stone. In their sawing machine for cutting stone from its natural bed, the saws are driven from one end only, the guide-frame being placed on the same axis as the crank-shaft by which the saws are driven. In this way the saws adapt themselves to their work at any angle, and each has an independent action.

BAILLIE'S VOLUTE SPRINGS.

The only springs shown in the Great Exhibition, which were lucky enough to gain a prize, were Baillie's volutes; and it is perhaps not too much to add, that their simplicity and excellence fully entitle them to this distinguishing honour. The material of which they are made is flat steel with parallel edges, but tapering in thickness from one end to the other. Such pieces of metal are wound spirally into a cone, so as to sustain pressure and deflection in the direction of the breadth of the metal. In bringing the invention before the readers of this *Journal*, we have selected as illustrations two examples of the springs as applied to railway purposes. Fig. 1 is a longitudinal section of a double-spring railway passenger carriage-buffer. The outer cylinder, A, bolted to the front buffer beam, has within it the two volutes, B C, set with their apices to-

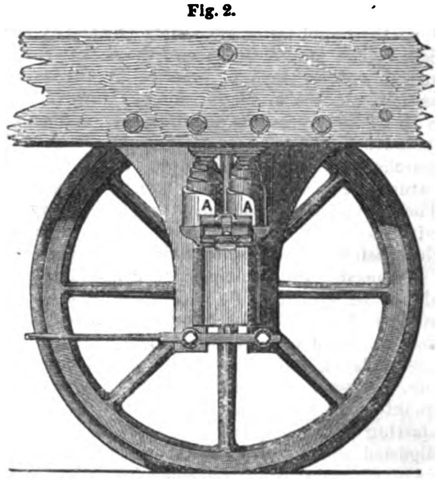
Fig. 1.



1-12th.

wards each other, upon a guide-spindle fastened to the cylinder bottom, this spindle having upon it a bearing disc to receive the pressure from the two springs, when forced towards each other. The short sliding cylinder, D, carrying the buffer disc on its outer end, is fitted to slide within the open end of the spring cylinder, A, and encircles one of the springs, B, a diaphragm being cast across the cylinder, D, to communicate the external pressure to the base of the spring, and to act as a further guide, by passing the spring-guide spindle through its centre. It thus forms a most compact buffer, one or more volutes being enclosed in the cylinder according to the extent of range required. The springs may also be fitted up by simply stringing two or more springs on the rods beneath the carriage body, and as the volutes do not interfere with the timbers of the trussed framing, a more simple and rigid structure is attainable with a smaller amount of woodwork.

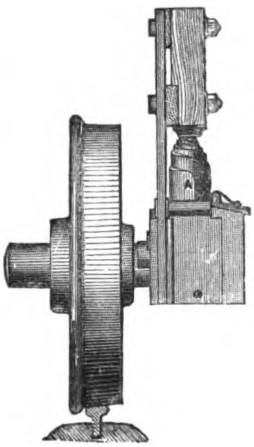
Fig. 2.



1-24th.

For engines and goods waggons a single spring only may be used, the most economical fitting being simply to fix them on the buffer-rod, beyond the end-framing, and if the springs need any protection, the timbers may be conveniently contrived with a hollow to receive them.

Fig. 3.



1-32d.

Fig. 2 exhibits a side elevation of a portion of a waggon-frame, with its wheel and axle-box, to show the application of the volutes as bearing springs. Fig. 3 is an end elevation of the same, drawn to a slightly smaller scale. The top of the axle-box has a short cross-bar, which answers to receive the bases of a pair of springs, A, set one on each side the line of the axle's centre, on guide-spindles—the apices, of course, abutting against the lower side of the frame. One spring in the centre may be used instead of two, but the duplex arrangement is much more efficient.

As drawing springs they are applied by passing through them a bolt with adjustable nuts, to convey the pressure to the apex of the volute. If placed at or near the centre of the carriage, they will act both ways, by using a short length of tube with a slot in the draw-bar. The latter can in this way lengthen itself, rendering great assistance to the engine in getting under way with a heavy train. It is claimed for this form of spring, that it is capable of sustaining equal loads with one-third the weight of steel necessary in the common spring. Although thus light, the peculiarity of action in applying the pressure edgewise to the coils, renders them remarkably free from liability to fracture, whilst, whatever amount of force is sustained by them, the coils are always brought up to a firm bearing at the end of their traverse.

The excellent specimens of these springs, to which the Exhibition prize was awarded, were made by Messrs. John Spencer & Son, of the Newburn Steel Works, Newcastle-on-Tyne.

GENERAL VIEW OF TRIGONOMETRY,

DERIVED FROM GEOMETRICAL PRINCIPLES BY ANALYTIC ARTIFICE, AND MADE SUITABLE FOR THE CALCULATIONS OF THE PRACTICAL MAN.

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I.

Before proceeding to the study of the analytic principles of Trigonometry, the student should make himself tolerably acquainted with the Elements of Euclid, the principles and practice of Algebraic Calculation, and the use of Logarithms. If he had done so, it would be easy to lay down their application even in its greatest extent to this subject; to establish, by the joint assistance of the first two, the whole of its principles, and to reduce them to practice by the united use of the last two—namely, algebra and logarithms. However, as few readers are familiar with all these previous acquirements, and as some of them are not even included in the ordinary class-books which guided our readers in their searches after these principles, many propositions of a preliminary nature are premised to the actual discussion of the subject in hand. Those who have already mastered them, may thus become more familiar with them; and those to whom any of them are new, may now observe them before proceeding to their application.

To master the principles, to consolidate and insure the foundation, should be a prime rule with those who turn their attention to a new subject of investigation or study, as much as with those who undertake new works of construction. The succeeding parts are then gradually accumulated, and, when once thus built up, they remain fixed and enduring. A loose stone in the foundation will cause the whole of the subsequent parts to appear doubtful and difficult. Hence the necessity of starting with the principles, every line of which should be carefully digested, every step in the deductions from them should be attentively followed, and clearly comprehended before proceeding to the succeeding inference. The beauty of mathematical science consists in its regularity of sequence, and the logical precision and exactitude of eliciting each conclusion from some previously established and admitted truths. It is on this account that such investigations are called the *exact sciences;* and it is hence that they derive their value as subjects of education, for training the reasoning faculties of the human mind, and making it quick and accurate in deriving inferences from known premises, besides their intrinsic value as practical guides in other sciences and manufacturing appliances.

The science of Trigonometry is so called, from the circumstance that its application was first made, and long continued to be chiefly confined, to the investigation of the relations which existed between the different parts of the triangle, (τρεις, γωνος, νομος,) as consisting of three lines, three angles, and an area. The subject has long since found a much wider range, and now regards the measurement of all angular magnitudes. The great desideratum has always been, some method of comparing the sizes of the angle with the length of the lines bounding the triangle—to make the whole seven magnitudes named commensurable, so that they might be mutually expressed in terms of each other. For this purpose, the comparative magnitudes of the angles must be represented by lines. Every one knows that the size of an angle does not depend on the length of the lines which contain it. Though *they* be extended *ad infinitum*, *its* value remains the same. Some lines subtending, and not containing the angle, must therefore be found. The circle possesses properties eminently suited for this purpose, and certain lines which may be drawn about it subsequently, furnish even rectilinear standards of comparison for varying angular magnitudes.

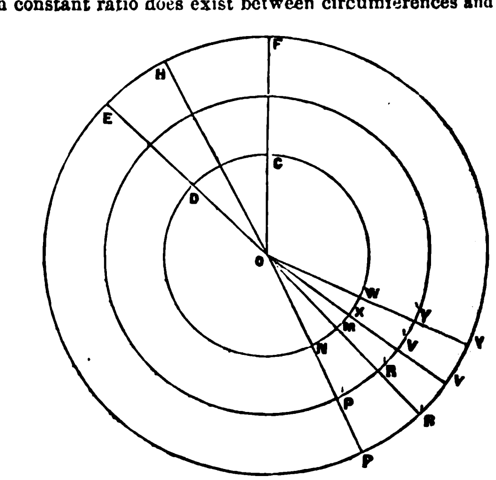
It becomes necessary, therefore, to advert particularly to some of the properties of the circle.

It can be shown that the diameter of a circle bears a constant ratio to its circumference; that is, if we know that one diameter is contained a certain number of times in its circumference, we also know that any other diameter is contained the same number of times in the corresponding circumference. Assuming that the diameter is equal to unity (one foot, one inch, one mile, &c.), the circumference would be found to be equal to 3·14159, &c. units (feet, inches, or miles, &c.) This number is therefore the constant ratio of the diameter to its circumference, and it is usual to represent it by the character π (περιφερεια, a circumference): in general, any circumference is equal to 3·14159 times its diameter; and *vice versa*, any diameter is equal to its circumference divided by π, or 3·14159. We shall denote the circumference by c, the radius by r ($\therefore 2r =$ the diameter), and the area by a; all of the same circle; wherefore, in algebraic parlance, $c = 2\pi r$, and $r = \frac{c}{2\pi}$. For example, if the diameter of a circle be 20 feet, what is its circumference? $c = 2 \times 3{\cdot}14159 \times 10 = 62{\cdot}8318$, since $r = 10$ feet. If the circumference of a pond be 100 chains, what is its diameter? $2r = \frac{c}{\pi} = 31{\cdot}8$ chains.

There are many methods of deriving this value of π, and it has been the subject of much labour to find it exactly, and establish the truth of some simple relation between these parts of the circle, being no other than the celebrated problem never yet solved—because not true—of the quadrature of the circle, on which volumes have been written, namely, to find a line whose square shall be equal to the area of a given circle; no such line exists.

The following process of reasoning seems as concise as any other of the numerous ones employed, for obtaining the value of π, and proving that it must be equal to 3·14159, *q.p.*

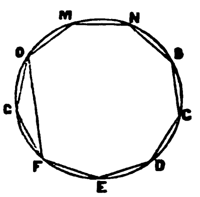
That some such constant ratio does exist between circumferences and their radii—that is, that any one circumference divided by its radius or diameter, is equal to any other circumference divided likewise by its radius or diameter—may easily be seen from the following arguments. Conceive any two or more circles ($nmxw$ and $prvy$, &c.) to be concentric about o. Each circumference may be viewed as consisting of an infinite number of infinitesimally small right lines—its elements. Let nm be one of these, pr is the corresponding element of the circumference, $prvy$; also, nm is parallel to pr, for the triangle



onm is similar to opr; $\therefore nm : pr :: on : op$. In like manner may be shown, that $mx : rv :: om : or :: on : op$, and so also of each pair of the elements which correspond to each other. Hence, *componendo*, the whole circumference, $nmxw : prvy :: on : op . \therefore nmxw \div on = prvy \div op = p'r'v'y' \div op' =$, &c., quite irrespective of the number of circles; wherefore we conclude, generally, that the ratio of the circumference of a circle to its radius or diameter is *constant*. It remains to prove that this constant $(\pi) = 3{\cdot}14159$, as already stated. It is evident from this method of demonstration, and may be inferred as a corollary, that the arcs of different circles which subtend equal angles at the centres, are also proportional to the radii of those circles, thus, $cd : fe :: oc : of$, &c.

It is of the utmost importance for our purpose, and may now easily be proved, that *in different circles angles at the centres are proportional directly* to the *arcs* on which they stand, and *inversely* to the *radii* of those circles. That the angles are directly proportional to the arcs on which they stand is proved in the 33d proposition of the 6th book of Euclid's Elements. It only remains for us to show the latter part of the proposition. Let eof or doc and hof be any two angles standing on equal arcs, cd and fh, of different circles; they are inversely as the radii of the circles, or $cod : foh :: fo : co$. Produce od to e: it has been proved above that $fe : cd :: fo : co$, but by hypothesis $cd = fh . \therefore fe : fh :: fo : co$. But the angle cod (or foe) $: foh :: fe : fh . \therefore cod : foh :: fo : co$. Thus we find that when the radius remains the same, the angles at the centres of circles are proportional to the arcs on which they stand (Euclid 6. 33), and that when the radii are different and the arcs remain equal $(fh = cd)$, the angles are inversely as the radii (meaning that the angle standing on the arc of one circle is proportionally *smaller* than the angle standing on an equal arc of another, as the radius of the former *exceeds* that of the latter circle). Combining these two relations into a compound ratio, we may state, as a general principle, that angles at the centres of different circles are directly proportional to the arcs subtending them, and inversely to the radii of those circles. Thus a connection is already established between arcs and angles, by which one may be made to replace the other in any calculation or comparison of magnitude. Before proceeding farther into details of this connection, let us investigate some method of determining the value of the constant (π) quantity which we have seen we shall require. The simplest method of approximating to it seems to be the following, which we shall discuss in detail, as many of the principles involved in it are omitted in elementary treatises on Euclid, being only deductions from these Elements.

The area of a circle is equal to half the rectangle contained by the circumference and its radius. From the 21st proposition of the Elements

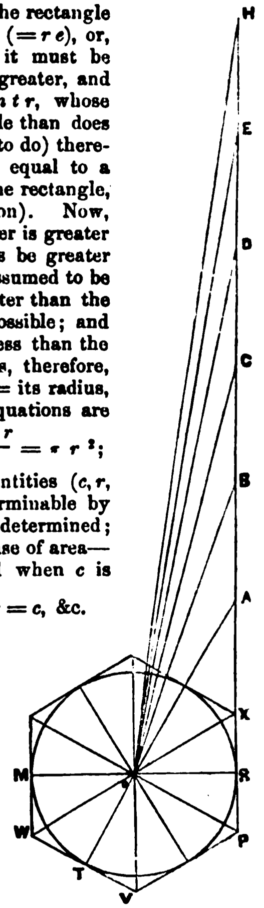


(that any two sides of a triangle are greater than the third side), if we suppose, as before, that the circumference consists of a succession of very small right lines, it follows that any *inscribed* figure, however small its sides, contains a *less*, and every *circumscribed* figure a *greater*, boundary and area than the circle. For by joining the remote ends of each successive pair of elements, a series of triangles is formed, from which any one may see the truth of the statement; of is less than $og + gf$, however small they may be taken; hence also, in the extreme case, when they are infinitesimally small, or when they merge into the circumference, this circumference is greater than the polygon in boundary; but still a small triangle, gof, remains for every two elements. The sum of these triangles all round constitute the difference of areas of the polygon and circle; and a similar method of reasoning would prove that the area and boundary of the circumscribed figure exceed those of the circle.

In either case, however, the boundaries and areas may be made to approximate each other within any assigned limits, by merely increasing the number of the sides of the regular polygon. The apothem of any polygon is the radius of the circle inscribed in it.

The area of any polygon which is *regular*, or which has equal sides and angles, is equal to half the rectangle contained by its perimeter, or boundary, and apothem. Let mxp be any such polygon, and inscribe a circle; draw also the lines in the figure, making $pe =$ the perimeter. The triangles, pox, pov, vow, &c., are all equal to each other, and so also are pox, xoa, aob, &c., because they have equal bases, and the same altitude, or. These equals are of the same number—namely, as many as the polygon has sides. Therefore the sum of the former (or mxp) is equal to the sum of the latter (or the triangle, poe), = the area of the polygon = the half of the rectangle contained by the perimeter (pe) and apothem (or).—Q. E. D.

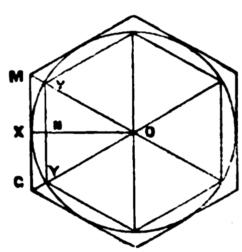
The area of a circle is equal to half the rectangle contained by the circumference and radius. This might be viewed as the extreme case of the truth just established, to which it merges, when the sides of the polygon become infinite in number, and the polygon becomes a circle without changing the relation existing between the area and certain demonstration. Let mtr be any circle. If its area be not equal to lines of it. It may also be inferred indirectly by an easy process of the half of the rectangle contained by or, and the circumference $(= re)$, or, which is the same, to the triangle ore, it must be greater or less than it. Suppose it to be greater, and circumscribe a polygon (mpx) round mtr, whose area shall differ less from that of the circle than does roe, (as it has been shown to be possible to do) therefore mpx is less than ore, but mpx is equal to a triangle (such as orh) whose area is half the rectangle, $or \times rh$ (= the perimeter of the polygon). Now, since it has been shown that the perimeter is greater than the circumference, orh must always be greater than ore; but we found that it might be assumed to be less than it, if the triangle, ore, was greater than the area of a circle—this cannot, therefore, be possible; and similarly, ore could be found to be not less than the area of the inscribed polygon. It appears, therefore, that when $a =$ the area of a circle, and $r =$ its radius, and $c =$ the circumference, the following equations are true: $c = 2\pi r$ and $a = \frac{cr}{2} = \frac{2\pi r \times r}{2} = \pi r^2$; wherefore, if any one of these three quantities (c, r, and a) are known, the other two are determinable by the two equations; if r be known, c can be determined; moreover, if r and c are known for one case of area—being the same for all—π can be found when c is known, and *vice versa*, for $r = \frac{c}{2\pi}$ and $2\pi r = c$, &c.



EXAMPLES.—If the radius of a circle be 100 feet, what are its circumference and area? $c = 2\pi r = 2 \times 3{\cdot}14159 \times 10 = 628{\cdot}818$ feet, and $a = r^2\pi = 3{\cdot}14159 \times 10000 = 31415{\cdot}9$ square feet. If the girt of a tree be 76 feet, what are its diameter and area of section? $d = 2r = \frac{c}{\pi} = 21$ feet nearly; and $a = \pi r^2 = 3{\cdot}14159 \times 10{\cdot}5^2 = 346{\cdot}36$ square feet. If the area of a pond is to be 7060 square yards, what must be its diameter? $a = \pi r^2 . \therefore 7060 = r^2 \times 3{\cdot}14159 . \therefore r^2 = (7060 \div 3{\cdot}14159) = 2244 . \therefore r = 47$ yards nearly.

It now remains to seek a method of calculating the value of π. We may observe again that its value can only be obtained approximately, but any assigned limit of accuracy or closeness to it may be attained. We have seen, that if for any one circle we know the circumference, the radius, and also the area, we could determine π by the equation $c = 2\pi r$, and that when we know the area and radius we may find c. There are several methods and principles on which processes may be established for finding the area of a circle of known radius. The following is one:—

Let $v \times v$ be any circle whose radius is one foot or one inch—one unit. Inscribe a regular hexagon in it. The area of this hexagon consists of six equilateral triangles. The area of each triangle is equal to the rectangle contained by on and $nv = {\cdot}866025$, &c., $\times {\cdot}5 = {\cdot}4330125$ square unit (inch, foot, or &c.) For $nv = {\cdot}5$ or $\frac{1}{2}$ of ov, which is taken as linear unit, and (Euclid 47. I.) $on = \sqrt{1^2 - nv^2} = \sqrt{1 - \frac{1}{2}^2} = \sqrt{{\cdot}75} = {\cdot}866025$, &c. Consequently, the area of the hexagon, which is six times this triangle, $= 6 \times {\cdot}4330125 = 2{\cdot}598075$, &c.



Again, circumscribe a regular hexagon about the circle, $on : ox :: uv : mg$, by similar triangles; that is, ${\cdot}866025 : 1 :: 1 : mg . \therefore mg = 1{\cdot}154585$, &c. Therefore, the triangle, $omg = mg \times \frac{1}{2}ox = {\cdot}577297$, &c., square inches, and the circumscribed hexagon = six times this $= 3{\cdot}463782$, &c., square inches.

Now, it is known that the area of the regular inscribed figure of twice the number of sides (in this case of *twelve* sides), is a mean proportional between these areas. Denoting it by x; $2{\cdot}598075$, &c. : x ::

$x : 3{\cdot}463782$. $\therefore x = \sqrt{2{\cdot}598075 \times 3{\cdot}463782} = 2{\cdot}999859$, &c., square units. For distinction's sake, we shall denote the inscribed hexagon by μ, and the circumscribed by ν.

Again, it is also a known principle in geometry, that the area of the circumscribed regular figure of double the number of sides (of *twelve* sides), is an *harmonic mean* between x and ν.

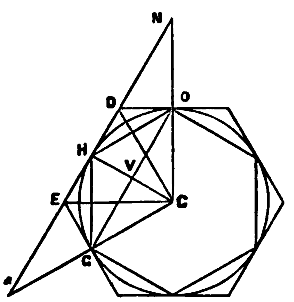
A quantity (x) is said to be an harmonic mean between two other quantities (m and n) when $m : n :: m - x : x - n$; or, the first is to the third as the first minus the second is to the second minus the third.

Wherefore, denoting the circumscribed figure's area by y; $\nu : x :: \nu - y : y - x . \therefore \nu (y - x) = x (\nu - y) . \therefore y = 2 . \nu . x \div (\nu + x) = 2 \times 3{\cdot}463782 \times 2{\cdot}999859 \div 6{\cdot}463641 = 3{\cdot}214812$, &c. By a similar process, the inscribed figure of twenty-four sides (t), being a mean proportional between x and y, may be found by the proportion, $x : t :: t : y$, to be equal to $3{\cdot}105508$ square units; and likewise the circumscribed figures (w) of twenty-four equal sides, being an harmonic mean between this (t) and y, is found to be $3{\cdot}143392$.

By repeating this simple arithmetic process a few times, the areas of the inscribed and circumscribed figures approach each other so closely as not to differ in the first six places of decimals—either may then be taken as the area of the circle, which constantly lies somewhere between their areas. Any greater degree of approximation might be obtained by extending the same calculation. This will, however, be near enough for our or any other practical purpose, when it is found to be $3{\cdot}14159$, &c., square units. This has been obtained on the supposition of the radius being *unity*, but the area $= \frac{1}{2}\, c\, r$. Therefore, when $r = 1$, $\frac{1}{2}\, c = 3{\cdot}14159$, &c., or when the diameter $= 1$, $c = 3{\cdot}14159$ &c. times 1; and it has been proved that this ratio is constant, or that the circumference of any circle is $3{\cdot}14159$, &c. times its diameter. The value of the area of any circle has been already stated, also in terms of r and c.

The facts which have been used in this method, namely, that the inscribed figure of double the number of sides has an area, which is a mean proportional between those of the inscribed and circumscribed regular figures having the same number of sides, and so of the harmonic mean, may now be proved geometrically.

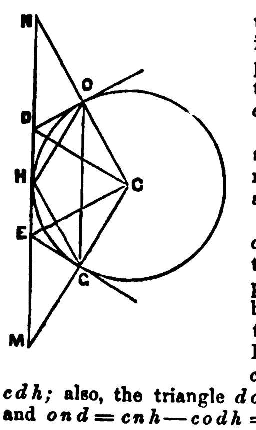
If x and y represent the areas of two regular figures of the same number of sides, inscribed (x) and circumscribed (y) respectively, about a circle ($o\,h\,g$), and if w represent another regular figure of double this number of sides inscribed in the same circle; w is a mean proportional between x and y, or $x : w : w : y$ and $w^2 = x \times y$.



Let $o\,g$ be one side of (x) an inscribed polygon in the circle $o\,h\,g$, draw the radii $c\,o$ and $c\,g$, and also the perpendicular $c\,v$; produce these lines, and draw the tangent $n\,m$, it is a side of the similar circumscribed figure (y); draw also $o\,h$, $h\,g$, &c., $o\,h$ is a side of the inscribed figure (w), of double the number of sides; and the triangles, $c\,o\,v$, $c\,o\,h$, and $c\,n\,h$, are each contained the same number of times by the polygon of which it is a part, namely, they are respectively the same part of x, y, and w; consequently, whatever proportions exist between them, also hold true of those polygons.

But $c\,o\,v : c\,o\,h :: c\,v : c\,h = c\,o : c\,m = c\,o : c\,n$. and $c\,o\,h : c\,n\,h :: c\,o : c\,n$ $\Big\}$ $\therefore c\,o\,v : c\,o\,h :: c\,o\,h : c\,n\,h$

Therefore, $c\,o\,h$ is a mean proportional between $c\,o\,v$ and $c\,n\,h$; wherefore also w, which is formed by repetition of $c\,o\,h$, is a mean proportional between x and y, which are respectively composed of a given number of times $c\,o\,v$ and $c\,n\,h$.



If, now, a regular figure, v, be circumscribed round the circle, having twice as many sides as x or y, the area of v shall be an harmonic mean between those of y and w.

Using the same figure, draw the tangents $o\,d$ and $g\,e$; $d\,e$ is a side of v; and now the triangles $c\,n\,h$, $c\,d\,e$, and $c\,o\,h$, are the same parts respectively of y, v, and w, $\therefore$ &c., as before the relations existing among these triangles, also hold true of the polygons. But the quadrilateral $c\,o\,d\,h =$ the triangle $c\,d\,e$, each of them being double the triangle, $c\,d\,h$; also, the triangle $d\,o\,h = c\,o\,d\,h - c\,o\,h . \therefore d\,o\,h = c\,d\,e - c\,o\,h$, and $o\,n\,d = c\,n\,h - c\,o\,d\,h = c\,n\,h - c\,d\,e$.

Now, $d\,o\,h : o\,n\,d :: h\,d : d\,n = h\,c : c\,n = c\,o : c\,n = c\,o\,h : c\,n\,h$. Introducing the valves of $d\,o\,h$ ($= c\,d\,e - c\,o\,h$) and $o\,n\,d$ ($= c\,n\,h - c\,d\,e$), and arranging, the proportion becomes $c\,n\,h : c\,o\,h :: c\,n\,h - c\,d\,e : c\,d\,e - c\,o\,h$; showing that $c\,d\,e$ is a harmonic mean between $c\,n\,h$ and $c\,o\,h$, for the first is to the third, &c.

Wherefore, also, v, which consists of $c\,d\,e$ a certain number of times repeated, is a harmonic mean proportional between y and w, which are made up of the same number of repetitions of $c\,n\,h$ and $c\,o\,h$.—Q. E. D.

It is evident that, however long the process of inscribing and ircumscribing regular polygons may be continued, the exact value of π never could be obtained; in short, that the circumference and radius of a circle are incommensurable—a fact which was first proved by Lambert, in 1761, who then set aside the long vexed question of "squaring a circle," —finding a line whose square should be equal to the area of a given circle, which had puzzled so many preceding mathematicians, and elicited such prodigious calculations. If such a square could be found, that is, if it existed, its ratio to the square of radius could be assigned, and the same ratio would have existed between the area of the circle and the square of its radius. Knowing this ratio, and assuming any radius, the area of the circle could have been at once obtained by multiplication. The circumference could then also have been found from the relation already established, namely, that the circumference is equal to twice the area divided by radius. Such simple or exact coincidences do not, however, exist, and an approximation only (within any assigned limits of accuracy) can be given: first, for the value of the superficies of a circle, when the square of radius is assumed as unit of area; and second, for the linear magnitude of the circumference of a circle, when the radius (or diameter) is taken as unit of length. Instead of $3{\cdot}14159$, Archimedes used the value $\frac{22}{7}$ for π; and Metius constituted a fanciful value for it, out of the odd numbers 1, 3, 5—namely, $\frac{355}{113}$. The former fails in the third, and the latter only in the seventh place of decimals; and hence, as they are easily recollected, they may be used when no greater degree of accuracy is required than these limits afford.

The student having proceeded so far, had better make himself familiar with the practical application of the principles already established, by solving the following and some similar examples, before attempting to enter into the next step in the subject.

1st, Find the circumference of the circle whose radius is 25 feet.

$$\frac{c}{r} = 2\,\pi . \therefore c = 2\,\pi\,r = 2 \times 3{\cdot}14159 \times 25 = \&c.$$

2d, What is the diameter of a circle whose area equals 700 square miles?

$$\text{area} = \frac{r\,.\,c}{2} = 2\,\frac{r\,.\,r\,.\,\pi}{2}\; (\because r\,.\,\pi = c) \,.\therefore \text{area} = \pi\, r^2;$$

or substituting the diameter for radius, by multiplying above and below it by the square of 2.

$$\text{area } (= 700) = \frac{d^2\,\pi}{4} = d^2 \times {\cdot}7854, \&c., \therefore d^2 = \frac{700}{{\cdot}7854} \text{ and } d = 29,$$

&c., miles.

3d, Find the radius of a circle whose circumference is 789·86 feet.

4th, Find the area of a pond whose circumference measures 70 chains.

5th, What is the area of a circle whose diameter is 20 feet?

6th, Find the area of a shadow caused by a table 4 feet high and 7 feet in diameter, having a candle standing on its centre, and 1·5 feet above it.

Here, from similar triangle, the radius of the shadow is a fourth, proportional to 1·5, 3·5, and 5·5, and is therefore 12·8 feet nearly, from which may be found the required area.

We have seen that angles at the centres of circles bear some convenient relations to the arcs on which they stand, by which these arcs may be made measures of the angles. To measure arcs themselves, however, involves some difficulty and trouble. For this purpose certain right lines are supposed to be drawn in and about the circle, and from the beautiful relations which will be found to exist among these and the arcs, formulæ and series are derived, which furnish the values of these varying magnitudes, as well as some remarkably useful relations and coincidences useful in every department of mechanical science and physical philosophy. Before proceeding to these, however, the circle itself demands some more minute attention.

The circumference of every circle is divided into *six* equal parts, called *sextants*, a division which arose from the use of radius as unit or measurer —the sextant being that arc whose chord is exactly equal to radius—and

into 360 equal parts, called degrees *(de gradus)*, probably on account of the observation, that the sun *circled* round the earth in about so many days or steps *(gradus)*. The sextant thus contains sixty degrees, a coincidence between *six* and *sixty*—between the radius stepping round the circumference, and the sun traversing the heavens—dotting his course round with night and day, which could not fail to excite the wonder and admiration of early astronomers, who therefore thought that they had authority in nature itself for establishing this—the sexagesimal division of the circle—which their successors now so frequently find very clumsy and unscientific. Pursuing this system also when more minute division came into requisition, each degree was divided into sixty equal parts, called minutes; each minute into sixty equal parts, called seconds; and so of seconds into thirds, of thirds into fourths, &c. Two perpendicular diameters divide the circle into four equal parts, called quadrants, each containing 90°.

Though this scale has existed for thousands of years, yet, in this practical age, many have to regret that some decimal scale has not been adopted; such, for example, as that introduced in 1790 by the French Assembly, who appointed a commission of the Academy of Sciences for this purpose, as well as to select scientific standards of weight and measure, &c., &c.

These commissioners divided the quadrant into 100 degrees, each degree into 100 minutes, each minute into 100 seconds, &c.

It is easy to interchange sexagesimal and decimal degrees, minutes, &c., from the known relation between them. Thus, since $90°$ sex. $= 100°$ dec.

As $90 : 100 :: 1'$ sex. : $1{\cdot}1111°$ dec.; and since 90×60 or $5400 = 100 \times 100$.

As $5400 : 10000 ::$ sex. $:: 1{\cdot}85185'$ dec.; and since $90 \times 60 \times 60 = 324000''$ sex. $= 1000000''$ dec. $\therefore$ 1 sex. $= 3{\cdot}086''$ dec.; and by reversing the process, as $100 : 90 : 1°$ dec. to $\cdot 9°$ sex., &c.

Now as 360°, that is, the circumference of one circle, is to 360°, that is, the circumference of another, so is the radius of the former to that of the latter; so also any other part or number of the degrees of the former, is to the same part or number of the latter in this ratio.

Thus 30° of one circle are to 30° of another, as $r : r'$.

Hence knowing r and π, any arc's length can be found, and conversely the number of degrees, &c. in that arc, which shall equal a given length.

Thus find the length of 20° of that circle whose radius = 100 feet.

$$2 \times 3{\cdot}14159 \times 100 = 360° \therefore 20° = 34{\cdot}906 \text{ feet.}$$

Find what arc is equal in length to radius, when radius equal 100 feet.

$$360° = 628{\cdot}318 \text{ feet} \therefore 100 \text{ feet} = 57°, \&c.$$

NOTE.—The same is true of the arc equal to radius in every circle = 57° 17′ 45″

The solution of the following examples will tend to give the student that degree of familiarity with this part of the subject which is requisite for his easy progress to the next.

1st, What is the radius of that circle whose arc of 43° 17′ 16″ is 73·4 feet?

2d, What is the length of a degree of that circumference whose radius is 150 feet?

3d, If, in a circle whose radius is 70 feet, an angle at the centre subtends an arc of 30° 7′ 19″, what is the length of the arc subtended by the same angle in a circle whose radius is 700 feet?

4th, Express an arc of 73° 19′ 17″ sexagesimal in French degrees, &c.

5th, Convert 798674″ decimal into sexagesimal degrees, minutes, &c.

6th, If the chord of a circle of 20 feet diameter be 9·7 feet, what is the length of the similarly situated chord in a circle whose radius is 60 inches?

NOTE.—Chords are similarly situated when they are chords of arcs containing the same number of degrees.

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COMPARATIVE PERFORMANCE OF CENTRIFUGAL PUMPS, WITH RADIAL AND CURVED VANES, AND TWO FORMS OF DISCS.

From a series of experiments recently performed before Sir John Rennie, Professor Cowper, Robert M'Carty, Esq., Dr. James R. Black, and other distinguished men, we have deduced the following table:—

1st, In a plain upright wooden case, with free space around the periphery of disc. Size 3 inches by 10.

Arrangement of Discs.	Time in seconds to fill the measure.	Rate of revolution per minute.	Fall of weight in feet to fill measure.	25 pounds of water raised to different heights.	Weight in pounds.	Friction about 70 lbs. in all cases. Per centage of power or duty performed.
Four radial	13	492	$1\frac{4}{10}$	1 ft.	111	
holes of	10	720	$1\frac{3}{10}$	1 ...	141	
discharge.	10	720	$1\frac{3}{10}$	1 ...	160	
Six	30	380	$1\frac{9}{10}$	1 ...	111	
curved	16	412	$1\frac{1}{10}$	1 ...	141	
vanes.	10	480	$\frac{8}{10}$	1 ...	160	

2nd, With moderate-sized annular channel around disc, and tangential discharge pipe, 1 inch diameter.

Four radial	35	686	4 ft.	4 ft.	141	
holes of	20	630	$2\frac{1}{10}$	3 ...	141	
discharge.	15	600	$1\frac{5}{10}$	2 ...	141	
...	12	600	$1\frac{3}{10}$	1 ...	141	
...	Very slight discharge.	600	00	4 ...	111	
...	35	566	$3\frac{3}{10}$	3 ...	111	
...	20	540	$1\frac{8}{10}$	2 ...	111	
...	15	480	$1\frac{2}{10}$	1 ...	111	
Six curved	No discharge.	550	00	4 ...	141	
vanes.	60	500	5	3 ...	141	
...	20	450	$1\frac{5}{10}$	2 ...	141	
...	12	450	$\frac{9}{10}$	1 ...	141	
...	No discharge.	510	00	4 ...	111	
...	Very slight discharge.	440	00	3 ...	111	
...	40	450	3	2 ...	111	
...	17	423	$1\frac{2}{10}$	1 ...	111	

From these experiments, it is apparent that the action of the curved vanes diminishes rapidly in effect, as the head or fluid pressure increases. This we may infer is caused by the curved vanes interfering with the *radial direction* taken by the fluid under the *laws of centrifugal force* at the highest velocities, which are necessary to oppose an increased pressure, whilst at low velocities they act as scoops or paddles, somewhat as an eccentric wiper or cam, in rotation, raises or pushes solid substances before it.

One of Mr. Gwynne's pumps, constructed as shown in our plate 76, for August last, having a single straight radial arm, has been employed for some time at Mr. York's works on the new Victoria Bridge over the Clyde at Glasgow. It is what is called by the inventor a No. 6 pump, and is worked by an engine of 12 nominal horses' power; the power actually expended on it is, however, only 8 horses. This engine is placed on the south bank of the river, and the power is conveyed from it to the pump, at a distance of 111 feet, by gutta percha belting. The quantity of water raised varies with the rate of revolution of the piston or disc, which is capable of ready adjustment to perform more or less work without loss of effect, according to the exigencies of the case. The highest quantity of water which has been raised from the coffer-dam has been calculated by Mr. Ginger, the superintendent, at 1,600 gallons per minute, with a rate of 600 revolutions of the disc. Its duty appears to be performed in a regular and continuous manner, and without any disturbance of the neighbouring piles, which always suffer from the vibratory action of the common reciprocating lift-pump. It has been frequently submerged by high tides, and has worked as well under water as above it.

RECENT PATENTS.

LUBRICATING MACHINERY.

H. C. Hurry, *Manchester.—Enrolled Nov.* 22, 1850.

This invention relates, in the first place, to the application of an apparatus within the packing of the moving parts of machinery, so formed as to act as an oil-distributing reservoir; secondly, to the application of a similar arrangement in the interior of steam-engine pistons; thirdly, to the formation of grooves on the peripheries of metallic pistons, for communicating with an internal reservoir; and fourthly, to the formation of reservoirs in the revolving shafts or axles which are to be lubricated.

Fig. 1.

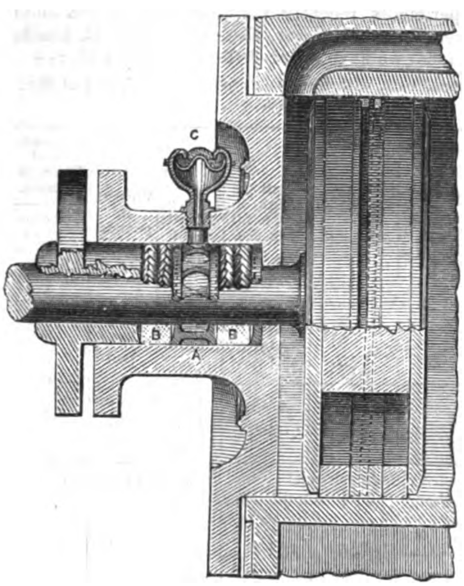
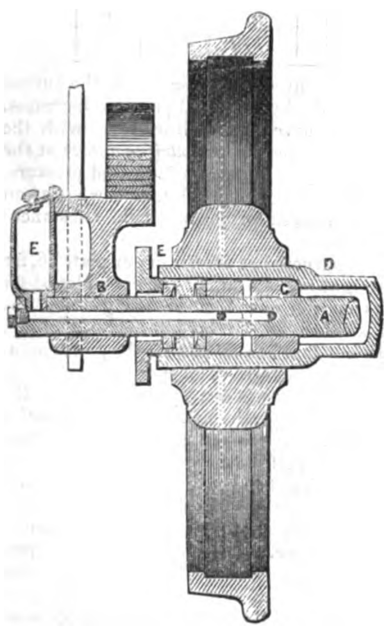


Fig. 1 of our engravings represents a longitudinal section of a portion of a locomotive engine cylinder, to which the first of these heads of improvement is applied. A skeleton bush or hoop, A, is placed in the interior of the stuffing-box, encircling the piston rod, and having on each side of it the usual packing, B, the whole being held down by a gland in the usual way. The external oil reservoir, C, communicates through the side of the stuffing-box with the skeleton ring, A, and the cavity formed by the latter around the piston-rod is thus kept filled with oil. By this means the oil is brought into contact with the rod over the entire circumference of the latter, and can only escape after lubricating the working surfaces, by passing through the packing. The oil-cup has a valved lid, kept close by a light spring, to exclude the dirt, and prevent the upward escape of grease.

Fig. 2.



In lubricating pistons, a reservoir formed in them has pipes passing to a skeleton hoop placed in the middle of the packing, and acting just as in the stuffing-box of the locomotive cylinder. The oil is supplied by an external cup in the cylinder cover, having a tube passing through the cover, and made to communicate with a valve opening through the upper side of the piston, from the oil reservoir within. When oil is to be supplied to the reservoir, the piston is brought to the top of the cylinder, when a communication is easily formed between the external cup and the internal reservoir.

A third arrangement refers to the formation of a spiral groove round the centre ring of metallic-packed pistons, such groove being in communication with an internal oil reservoir by suitable channels. By disposing the groove spirally, the reciprocation of the piston causes the lubricating fluid to be projected upwards, and thus be better distributed. The groove is represented as formed on the piston in fig. 1. The last branch of improvement is illustrated by fig. 2, which is a vertical section of a portion of a railway carriage axle, box, and wheel. The internal solid axle, A, is supported at each end in plumer blocks, B, and does not revolve. It has placed upon it two brass steps, C, and over these is a hollow axle, D, revolving with the wheels. The ends of this axle are filled up with a little packing and a gland, E, thus forming a chamber for the oil supplied from the cup, F. The bottom of this cup opens into the fixed axle, A, through a small hole drilled in the latter.

STRETCHING AND DRYING FABRICS.

S. Morand, *Manchester.—Enrolled July* 30, 1851.

Mr. Morand's invention has reference to the production of the "elastic finish" of woven fabrics. The fabric to be finished has its selvages pressed down upon a series of holding-pins, by a pair of wheels coated on their periphery with vulcanized india-rubber. These pins are arranged on a pair of endless chains, formed of a number of short links in the usual way, and made to travel along tortuous or serpentine guides. Each chain passes round a pair of horizontal pulleys, one at each end of the machine; and the fabric carried upon the chains, from the feeding to the delivery end, is taken up at the latter by a roller having a "card" surface; after which it passes partially round a series of rollers, and is finally deposited in a suitable receiver. The radii of the curves forming the serpentine-guiding grooves are of considerable length—that is, each curve is very flat, sweeping easily into its neighbour; and the links of the chain are excessively short, in comparison with the length of each curve. Each link has a double and a single eye, the connection being made by inserting the single eye of one into the double eye of the other, and passing a vertical connecting-pin through the two. The holding-pins are set in metal caps standing up from each joint, and having projecting side-flanges, by which they are held down, with the assistance of a short horizontal pin passed through. The chains are prevented from being dragged out of their grooves by the tension of the fabric, by forming the groove of such a section as to admit the projecting head of the pin which holds down the caps, a continuous strip of metal being screwed down to the top of the guide-rails, over the line of traverse of the pin. The rails are suited to various widths of cloth by transverse adjusting screws passing through brasses in each rail, the entire series of screws being actuated simultaneously by connected gearing.

The fabric is slightly moistened as it passes, by steam issuing from the minute perforations in two pipes beneath, the subsequent drying being effected by passing it over a heated flue.

The patentee states that he produces the common finish by using straight guides, instead of the tortuous ones which we have described; and he adds, in conclusion, that he is aware of fabrics having been stretched and dried by giving their selvages a tortuous or zig-zag course, and therefore does not claim it, but what he claims is the hereinbefore described arrangement for producing the elastic finish.

As it may hereafter become a legal question as to what the "hereinbefore described arrangement," as claimed, really is, we shall leave that knotty point for such a decision, if it is ever thought worth while to investigate it. But we cannot, at any rate, overlook the fact of the strong resemblance between Mr. Morand's plan and a hash of Mr. T. L. Paterson and Mr. Gratrix's patented inventions; either of which plans, by the way, appear to compass all and more than the scheme before us.

REGISTERED DESIGNS.

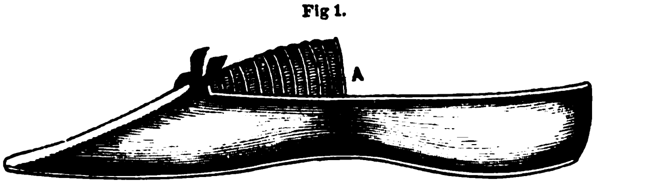
ELASTIC SHOES.

Registered for Messrs. C. & J. Clark, *Street, Glastonbury, Somerset.*

These shoes, three separate designs for which have been registered by Messrs. Clark, have been contrived for the purpose of securing elasticity over the instep; and, in one instance, across the foot. Our engravings exhibit two of these forms. Fig. 1 is a side view of a shoe, so arranged that due elasticity is obtained at the instep, by the introduction at that part of the elastic material, A, which at the same time presents the external appearance of a sock or stocking. The plan, fig. 2, is a second form, wherein elasticity is secured along the front by the

introduction of the slip of elastic fabric, B. A third plan is called by the inventors, the "Mitre Shoe," each side of the instep being cut to a sort of sloping notch, to receive a piece of elastic fabric of a mitre shape.

Fig 1.



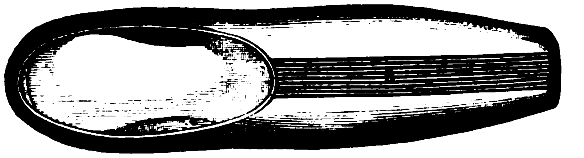


Fig. 2.

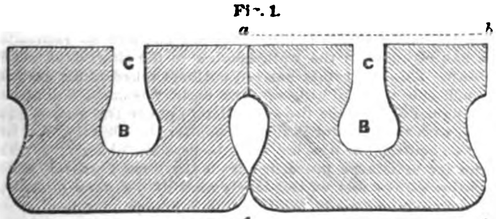
Messrs. Clark contributed some specimens of their productions to the Great Exhibition, and have been awarded a prize medal for a most ingenious expanding golosh. This golosh is made of gutta percha, and what is called the "waist" is divided across, and a piece of elastic material being interposed between the two edges, answers for the elongation and contraction of the length.

DRAIN PAVEMENT.

Registered for Mr. W. Forbes, *Newark Brick Work, Ellon, Aberdeenshire.*

This invention bears very importantly upon the question of the drainage of the floors of agricultural buildings—the object being the combination of an effective form of water duct or channel with the body of the tiles employed for paving byres and stalls for cattle. Fig. 1 of our engravings represents an end elevation of two tiles arranged to form part of a floor constructed on this principle; and fig. 2 is a corresponding plan of the same, showing also the transverse end channel, A, into which the fluid runs from the ducts, B. In this arrangement, the width of each tile is from *a* to *b*, in fig. 1, a narrow rectangular groove, C, being formed along the centre line of each. As the fluid flows from the surface down these grooves, it finds its way into the expanded portion, B, beneath, in the body of the tile, whence it flows freely off into the end channel, A, which has transverse passages formed in it, corresponding to the section of the tile ducts—leaving the tile surface clear and dry. Mr. Forbes also shows a similar arrangement of floor, in which the ducts are set at half the distance apart of those which we have illustrated, the joints or division lines between each tile being along the centre of each alternate duct. Flooring of this kind is obviously well adapted for the purposes of the farmer, as well as for other situations where much fluid has to be run off quickly.

Fig. 1.



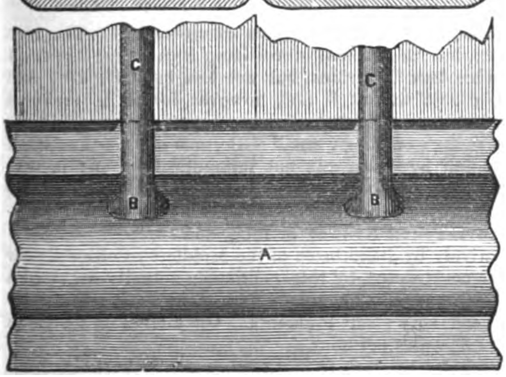


Fig. 2. 1-4th.

BLIND FURNITURE.

Registered for Mr. R. Harcourt, *Birmingham.*

This is an improvement on the single cord-roller blind for windows. Our illustrative figures present three views of the apparatus. Fig. 1 is an inside elevation of the roller mechanism, attached to the left side of the window; fig. 2 is a corresponding elevation of the roller with its apparatus on both sides, complete; and fig. 3 is an interior view of the mechanism on the right side of the window. A, Is the blind-roller, broken away in the middle, having at one end a ratchet wheel, B, fixed to its spindle, into which wheel a detent, C, is made to gear, being set on a stud centre in the side of the supporting bracket, and pressed into gear with the teeth by the spring, D. The detent, C, has a projecting tail, beneath which the end, E, of a second and larger lever, also working on a fixed stud centre, is made to engage, a cord being attached to the opposite end, G, of this lever. This is the disengaging cord for lowering the blind. By pulling it, the detent, C, is relieved from the teeth of the ratchet, and the blind then descends by its own weight, until stopped by letting the detent again fall into gear.

Fig. 1.

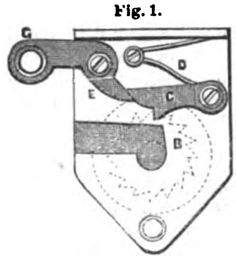


Fig. 2.

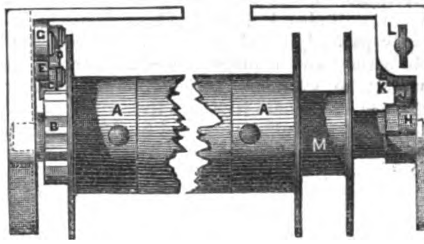
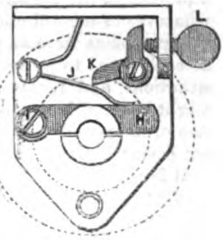


Fig. 3.



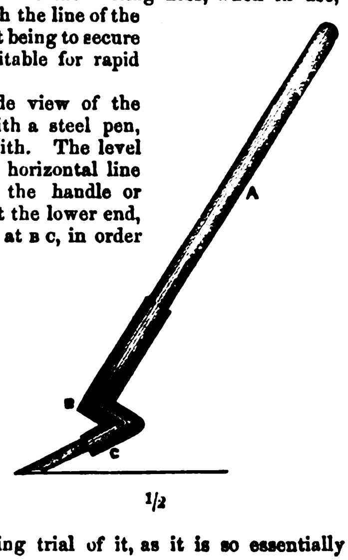
The bracket on the opposite side of the window carries a lever, H, set on a centre at I, and arranged to bear down the cord of the roller-spindle into its seat by the action of the spring, J, above; which, again, is pressed upon by one arm of the bell-crank lever, K, the opposite arm abutting against the end of the set screw, L. By means of this screw, any requisite amount of elastic pressure may be given to the lever, H, so as to afford a means of nicely regulating the friction of the spindle on its bearing. The blind is of course elevated by a cord over the pulley, M, which is wound up for action by the descent of the blind itself.

OBLIQUE PEN-HOLDER.

Registered for F. S. Bremner, Esq., *Camden Town, London.*

The peculiar novelty in Mr. Bremner's design arises from the so shaping the holders of steel pens, that the writing nibs, when in use, shall act at a very acute angle with the line of the paper being written upon, the object being to secure a free gliding action, especially suitable for rapid writers.

Our engraving represents a side view of the "oblique pen-holder," as fitted with a steel pen, and in the act of being written with. The level of the paper is represented by the horizontal line beneath. The upper portion of the handle or holder, A, is straight, as usual; but the lower end, near the pen, is bent, or angled, as at B C, in order to bring the termination, carrying the pen, to that acute angle with the line of the paper, which it is the object of the design to secure. When so arranged, the pen is enabled to glide freely over the paper without catching, whilst the writing action is smoother and more agreeable to the writer than when the pen is set to act at the ordinary obtuse angle.



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So eccentric a form of holder must evidently be awkward in the hand of a writer on first making trial of it, as it is so essentially

different from the ordinary quill or straight holder; but practice may possibly remove the difficulty of management, which the pen we now write with shows to be more imaginary than real.

REVIEW.

Railway Machinery: a Treatise on the Mechanical Engineering of Railways, embracing the Principles and Construction of Rolling and Fixed Plant, in all Departments. By Daniel Kinnear Clark, Engineer. Parts I.—V. Blackie & Son.

The proudest triumph to which the living race of engineers can point, is unquestionably the system of land locomotion, which has grown to maturity under their hands. The by-gone generation did its work, and nobly, in the exercise of the inventive faculty: it laid the foundations of our manufacturing superiority. As a first step, it infused new life and spirit into the steam-engine, enlarged its capabilities, and raised it from the mean condition of a miner's drudge—doing its work, as other slaves do, very slovenly and very reluctantly—to the high position of a world-civilizing agency. It passed into our hands well trained to all kinds of stationary work: it could pump water, grind, spin, and weave, with all supposable success; and it had made more than promising progress in river and coasting navigation. It had already multiplied a hundredfold the resources of these islands, and offered fairly to set free whatever of mental energy was still absorbed in mere brute-labour. Its idiosyncracies were as yet only partially developed, but it had been sufficiently tried to prove itself patient and manageable in all imaginable situations, and ready to undertake whatever duties living ingenuity might succeed in imposing upon it. There it was, a living concentration of industrial power, economical and ubiquious, and intelligence had not been wanting in the direction of its energies.

It is the great triumph of our age that we have taught it to travel by land as well as by water, and that, too, with a nimbleness of foot which even the imagination of a Scheherazade would not venture to exaggerate. It is in this limited capacity of land-carrier that we have presently to do with the tame gorgon—as the iron-horse of eastern fable and western reality. It is this phase of its character which Mr. Clark has brought under our notice in the work whose title-page is prefixed. The work, however, has a wider reach than the merely technical details of the locomotive engine—it embraces railway machinery generally, of which the engine is only part. That a first-class work of this kind is needed—a systematised exposition of the multitudinous relations which are necessarily included in the working of a line of railway—is more than obvious. We already possess, it is true, many essays, and some works of no mean pretension, and, we may fairly add, of no mean merit, treating of special departments; but there is no work to which we can refer with confidence of finding a question of engineering detail settled by reference to trustworthy data, or data of any authority. Works of this kind have, unfortunately, for the most part, been compiled by those little acquainted with working details, and are therefore rarely more than outlines of prominent features selected for popular effect. For this the authors are not responsible. They have generally made the most of the materials within their reach, but without knowing what was required, or where to find it. They have written without resources, internal or external, and presumed to instruct without being themselves instructed.

The literature of the arts, is, in this country, confessedly very defective. We are too much occupied with the arts themselves to attend to the registration of the steps by which we pass from one state of progress to a higher. When we have reached a useful application, we immediately begin to seek out ways of cheapening the processes; but it is only by some accident that any record is made of the trials and errors through which the end is finally attained. Many excuses are offered in extenuation of this neglect: want of leisure, and, more commonly, secretiveness of practical men, and inaptitude in recording their experience. But none of these reasons, nor all combined, suffice to account for the meagreness of this department of our literature. The fundamental reason consists in the very common and deep-seated feeling, that all less perfect modes ought to be concealed, and if by any accident they become known, that they ought to be forgotten as soon as possible. Every practical man seems to feel—does feel—in some measure disgraced, not only by having his name associated with an unsuccessful scheme, but even by having it coupled with methods of proceeding which after experience has shown were incomplete. It is natural to be ashamed of our imperfections, and it is only after a generation has lapsed that we can look with complacency on the first rude attempts of the practical mind labouring towards the realization of some noble conception. We now look with awe on the rude model in which the immortal mind of Watt was first embodied; but could Watt, with all that great magnanimity of mind for which he was no less remarkable than he was for the clearness of intellect, by which he has made his influence felt on the industry of the civilized world, have looked in after years with complaisance on an exhibition of his immature attempts to embody the dawning conception of his engine in a tangible form? Most certainly not. Even the most unequivocal success could not have reconciled him to a revelation of the crudities through which he had passed, and which must have appeared to lessen his claim to that perspicacity of mind for which the matured result had obtained him credit. Human nature is ever the same; and the natural curiosity that prompts us to pry into the history of any great idea successfully worked out, is met by an equally intense and natural feeling on the part of those immediately concerned to conceal the labour of the achievement. The mechanical discoverer, like other discoverers, has no objection that we reckon up the difficulties he has surmounted; he is ready to acknowledge all these without concealment and without abatement, but he has no desire that we should look narrowly into, and comment on, the devious line by which he has reached the summit. It is much more consonant with his notions of meritorious action, that we should believe his elevation attained *per saltum;* and to assure himself of his position, he obliterates, as far as possible, even from his own mind's eye, the steps by which his ascent was effected.

This antipathy to the revelation of abortive schemes has operated on the history of railway mechanics. Many of those schemes came, indeed, to light, and sometimes they even passed through the patent office, but usually they flickered so briefly and so faintly as to render it no easy task, even at this short date, to trace with certainty the progress of the locomotive itself, the main and most prominent member of the system, from its state of nonage to its present mature and efficient condition. We are therefore under no small debt to Mr. Clark for the succinct chapter of history which precedes the more technical material of his book. This chapter leads us as far back as 1650; not to the beginning of the tramroad system, for tramroads are probably older than history itself, but to a point at which we incidentally find them in operation throughout the coal districts of England. And it carries us down to 1830, when all the essential features of the modern locomotive were fixed, leaving only special details of proportion and construction to be wrought out from the data which coming experience would not fail to afford.

It appears that the merit of first suggesting the practicability of a steam-locomotive is due to the illustrious Watt. The idea seems to have occurred at least as early as 1759, and found its way into the patent of 1784. It was in this year that Watt's friend and assistant, William Murdoch, made the model, of which it is recorded by Mr. Buckle of Soho, that—

"One night, after returning from his (Murdoch's) duties at the mines (in Redruth, Cornwall, where he resided some time in charge of the mining engines), he wished to put to the test the power of his (locomotive) engine; and as railroads were then unknown, he had recourse to the walk leading to the church, situated about a mile from the town. This was rather narrow, but kept rolled like a garden walk, and bounded on each side by high hedges. The night was dark, and alone he sallied out with his engine, lighted the fire (spirit lamp) under the boiler, and off started the locomotive, with the inventor in full chase after it. Shortly after he heard distant despair-like shouting; it was too dark to perceive objects, but he soon found that the cries for assistance proceeded from the worthy pastor, who, going to the town on business, was met on this lonely road by the fiery monster, which, he subsequently declared, he took for the Evil One *in propria persona*."

This was undoubtedly the first locomotive steam-engine. The idea originated with Watt, but the honour of realizing it in a tangible form must be accorded to his less illustrious, but not less indefatigable, and still more retiring, coadjutor. It is not, however, for us to create a rivalry where none in life ever existed.

This experiment, though on a very small scale, was sufficient of itself to prove that locomotion by steam was not impracticable; but it was not till the present century was two years old, that the iron-horse was practically harnessed to a load. This was successfully effected by Trevithick on the Merthyr-Tydvil Railway in 1804, and seven years thereafter still more effectively by Blenkinsop of the Middleton Colliery, near Leeds. The engine constructed by this gentleman actually attained a speed of ten miles an hour on a level, and with light loads; and with 15 tons it could ascend very steep gradients. On a level its load was 94 tons, at a speed of 3½ miles per hour.

Here, then, was a point to start from on the path of improvement. The practicability of steam locomotion was thoroughly established, and no wonder the noble proprietor of the Bridgewater canals was alarmed by the progress of those "d—— tramroads."

It remains, however, to be told, that something of the efficiency of this engine in ascending gradients, appears to have been due to a clumsy scheme for insuring adhesion of the wheels. This consisted in the application of a rack laid alongside of the railway—by patent of course—and this rack was geared into by spur-wheels attached to, and driven by the

engine. This rack-rail was not discontinued until, by a better distribution of the load on the wheels, it was proved by Blackett that the simple adhesion of the wheels was sufficient to take up the whole power of the engine.

In 1814, George Stephenson entered the field with an engine of no very promising construction, but which the year after he much improved (in conjunction with Mr. Dodds); and at this point the history subsides into mere technical details, all important enough to the minute student of mechanical progress, but which have no marked character of general interest. The next great step in advance brings us down to 1827, when Mr. Hackworth, manager of the Stockton and Darlington Railway, seems to have applied the blast-pipe in the chimney of an engine named the Royal George, to stimulate the draught of the furnace. This was a great step, though little valued at the time. It was indeed regarded as an "accidental circumstance," which, although it promoted evaporation, wasted fuel, and Mr. Wood endeavoured to avoid the supposed evil by enlarging the flue-tube, and thereby increasing the heating surface.

The next, and it may be regarded as the final step in the completion of our modern conception of a locomotive, is claimed by our Gaulic neighbours. Hitherto, boilers had been made commonly with only a single flue-tube; the generation of steam with rapidity sufficient for high speeds, in boilers of moderate size, was therefore impracticable. How this was remedied is told by M. Lobet *(Des Chemins de Fer de France)* as follows:—

"The first locomotives, two in number, that were sent to France, were made by George Stephenson, and arrived there in 1829, for the Lyons and St. Etienne Railway, of which M. Seguin was the engineer. On trial, their mean velocity did not exceed 4 miles an hour. To increase the efficiency of his engines, M. Seguin felt the necessity of increasing their evaporating power, and resolved to apply a scheme of his own to the engines he was about to construct on the model of Stephenson's—a scheme which he had cherished since 1827, and had patented in February, 1828, and which consisted in multiplying the heating surface, by so dividing the current of hot air into streamlets, which flowed through a series of tubes immersed in the water of the boiler. This method of arrangement amazingly increased the heating surface, and, in consequence, the evaporative power of the boiler; and it is essentially to this augmented evaporation, that we are indebted for speeds which were before thought impossible. But another difficulty presented itself; the height of the chimney, necessarily limited, was incompetent to maintain the draft, the resistance of which was so much increased by the increase of surface in the new boiler. M. Seguin therefore added a circular fan for promoting the draft, and it was partially successful. M. Pelletan, however, completed the solution of the problem, by suggesting the steam-jet in the chimney; and, as usual, England appropriated the invention of the two French engineers."

On this statement and charge of plagiarism, Mr. Clark enters the following qualification:—

"The suggestion and application of the subdivided tube surface is, by common consent, ascribed to M. Seguin. The steam-jet in the chimney, though no doubt invented independently by M. Pelletan, had been, as we have seen, previously applied by Stephenson and Hackworth. It was, however, at the time but partially employed in this country, as we may infer from the absence of the jet in the sample engines sent to France. The method of multitubular flue and the steam-jet are parts of one system; they co-exist as naturally as the condenser and air-pump of Watt's engine. The locomotive was not ripe for the application of the blast-pipe; the large and vacuous cavity of the flue-tube, while it presented a very restricted area of heating surface, permitted great freedom of circulation; and the greater length and surface of Hackworth's double flue enabled him, on this account probably, to employ the blast with greater success than had been done by his predecessors. Again, the tubes of M. Seguin, while they increased the heating surface, increased the friction surface of the flue-way simultaneously; and here it was that the aid of mechanical expedients became more than ever necessary to uphold the requisite rate of combustion. The method of the steam-blast, therefore, of spontaneous invention at home, was in France the child of necessity. The tubes formed the link between the fire-box and the jet, and thus the problem of producing a light and powerful locomotive was solved."

These remarks are sufficiently well weighed and judicious, and afford a fair sample of Mr. Clark's narrative style. The language, though free, more so indeed than we usually find in works of a technical kind, is not faultless, and when metaphor is attempted, a much stronger term might sometimes be applied. Supposing, for instance, that we should happen to read the preceding paragraph in a non-poetical mood, we might feel inclined to ask what kind of child a "child of necessity" is, and what analogy there is between a "method of steam-blast," and a child of any sort? We might also demur to making "the tubes" a *link* between "the fire-box and jet."

We advert to these minor blemishes of style, because we hope to see them diminish as the work proceeds. They are not vital—rarely detrimental to the sense—which, indeed, is always clear enough, and seldom mistakeable; but the expression often seems hurried, as if the author's ideas flowed more rapidly than his pen can transfer them to the sheet, and he felt it necessary to take the words that first present themselves, without troubling himself overmuch about proprieties.

But returning to the matter:—The locomotive, with its multitubular boiler and blast-pipe, was now an efficient engine: the velocity was no longer limited by the capability of generating steam. It was not, however, until the directors of the Liverpool and Manchester Railway, perhaps unaware of what had been done in France, had offered a premium for the best locomotive that should draw a load of three times its own weight on a level, at 10 miles an hour, that the Rocket was produced (by Mr. Robert Stephenson), and marked the beginning of a new era in the railway history of this country. We cannot follow Mr. Clark in his interesting account of the engines put in competition, and their respective performances: it is sufficient to note that the Rocket was the only one of the three that accomplished the stipulated distance of 70 miles; and that its average speed was 13·8 miles, and its maximum 29 miles, per hour.

The leading principles of construction being thus settled, the details were varied and investigated by several engineers simultaneously. Among the names most prominent in Mr. Clark's narrative of this period, after Stephenson, are those of Bury and Hackworth. Bury's four-wheeled engine, the first of a class which made his name afterwards distinctive, was placed on the rails (Liverpool and Manchester Railway) on the 22d July, 1830. Hackworth is a name now less widely known; but accepting the summary of his contributions to the progress of railway engineering, drawn up by Mr. Clark, it appears that, up to 1830, no single individual in this country had done so much for the improvement of the locomotive.

"He first employed six coupled wheel locomotives; he first applied the waste steam to heat the feed-pumps, which, in many cases, is a matter of convenience; he substituted spring balances for weights to the safety-valves; he schemed, and first applied the steam chamber in the boiler * * for obtaining dry steam; he first placed the cylinders beneath the boiler, and employed the double inside crank-axle, coupled directly to the pistons; and he also was the first to employ, in railway locomotives, a separate crank-shaft, hung in bearings fixed to the frame."

We cannot follow Mr. Clark through his second chapter, which is taken up with what may be called the modern history of the locomotive. This chapter is, by far, the most important to the engineer, in a professional point of view; and it is at once concisely and fully written. It is only, indeed, at this point that Mr. Clark appears to enter upon his subject *con amore*. The chapter of older history seems to have been written because it was necessary; it has not, at least, the freedom and density of expression which we meet with in subsequent chapters. We quote the following sentences from the concluding pages of the general history, not as the best sample that might be selected of the compactness with which the facts are piled together, but because of their relation to the branch of the subject to which we have purposely confined our remarks for the present:—

"The history of one or two railways is the history of all: the main features are identical. The leading facts are—that on the first introduction of passenger railways, speeds of about 12 miles per hour only were anticipated; the rails thus employed weighed only 35 lbs. per yard, and the engines from 5 to 7 tons. When speeds of 20 and 24 miles were attempted, it was found necessary to have 50 lb. rails, and engines of 10 and 12 tons. The engines were thus divisible into two classes: four-wheel engines and six-wheel engines, patronised respectively by Bury and by Stephenson, as the leading makes. As speed and power, convertible terms, increased, more accommodation was wanted; outside cylinder engines therefore were constructed, weighing 15 and 16 tons; inside cylinders continued in vogue, as, by simplification of the machinery, accommodation was provided for them. In other quarters, the guage of the railway having been increased 50 per cent. upon the previously existing guage, the constraint incidental to the inside cylinder was very much relaxed, and still more powerful engines were made, weighing, from first to last, 15 to 35 tons charged. On the ordinary guage, too, the boilers of the engines were lengthened, and the fire-box increased, and the long boiler engines was the result, weighing from 20 to 22 tons. Finally, as some of the later engines on the common guage had, owing to peculiarities of construction, acquired a character of unsteadiness at high speeds, and of increased cost of maintenance, Crampton's engine was introduced, in which the wheel-base was extended and more solidly arranged, the driving-wheel being placed behind the fire-box, and the boiler lowered considerably. Meanwhile the rails were increased progressively to 65 lbs., 75 lbs., and 85 lbs. per yard.

We must here pause for the present. We have followed Mr. Clark only through a comparatively unimportant suburb of his undertaking; but next month we promise ourselves a more agreeable duty, in dealing with some of the vital doctrines which he has laid open for our consideration. Meantime it is due to Mr. Clark and the publishers to state, that the work is highly creditable to both: it is eminently practical in its material and mode of treatment, and is elegantly printed, and most profusely illustrated. The plates are of a good style of workmanship, fairly drawn and engraved; and what is of the utmost moment to the engineer, the examples are well chosen and fully detailed, and all the sizes of the smaller parts are distinctly marked. They are generally, indeed, so complete as to admit of being taken into the workshop, and wrought to without further explanation than appears upon them. The minuter and less important modifications and differences of particular makers are

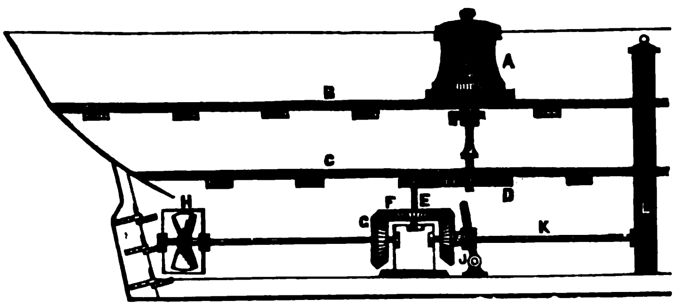
further compared and illustrated by woodcuts; and the quantity of these, incorporated with the letterpress, forms a most important feature of the work. The large sheet of indicator diagrams in Part IV., and those of valve diagrams in Parts I. and II., are, to us, especially interesting: they contain a treatise in themselves.

CORRESPONDENCE.

COMMANDER INGLEFIELD'S PLAN OF DRIVING THE SCREW-PROPELLER FROM THE CAPSTAN.—IMPROVED ANCHOR.

My accompanying sketches represent these proposed improvements, as shown by me in the Great Exhibition. Fig. 1 is a longitudinal section of the stern portion of the "Flying Fish," 10-gun brig, fitted with a screw-propeller, so connected with the capstan, that the ship may be easily moved a-head during a calm, by manual power applied to the windlass. The arrangement also combines a plan whereby the ship is enabled to pump herself clear by the effect of the screw, when passing through the water, either by the wind, or in a tide way. The sketch pretty fairly explains itself. The capstan, A, has a vertical shaft passing

Fig. 1.



down through the upper deck, B, to just beneath the lower deck, C, where it carries a spur wheel, D, gearing with a spur pinion on the upper end of the short vertical shaft, E. The lower end of this shaft has upon it a bevel wheel, F, in gear with a bevel pinion, G, on the horizontal shaft of the propeller, H. The same wheel, F, also gears on its opposite side with the pinion, J, on the horizontal shaft, K, driving the chain pump, L. Both the main shaft of the capstan, and the horizontal shaft of the pump, are fitted with disconnecting apparatus for cutting off the connection of both with the capstan. Such an arrangement is evidently well adapted for working, when the vessel is in port, for actuating ventilators, wash-deck pumps, or even yarn spinning.

Fig. 2 is a side elevation of my improved anchor, without a stock, as it

Fig. 2.

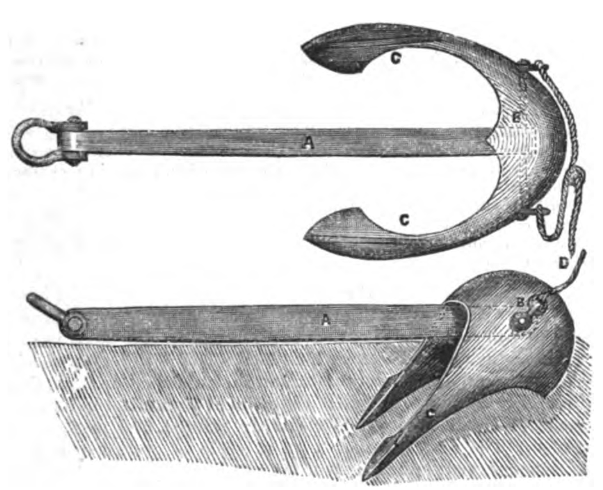


Fig. 3.

appears when in the ground. Fig. 3 is a corresponding plan of the anchor. In addition to its being stockless, it takes into two parts for the convenience of stowage, and both flukes enter the ground. The shank, A, it will be seen, is connected at B by a joint bolt, with the hollow crown of the flukes, C; D is the buoy rope. It is impossible to foul this anchor, whilst, as to its construction, it is more simple in form than the common anchor—no welding being necessary—and it has double the hold of any anchor at present in use. It also possesses the great advantage of exposing nothing above ground that can foul another cable, or injure a vessel riding over it in shoal water.

E. A. Inglefield,
Commander, R.N.

Camperdown, Dundee, November, 1851.

[Our correspondent's anchor is an obvious modification of Porter's patent, but clearly possessing the several advantages here claimed for it by its inventor.—Ed. P. M. Journal.]

SHARP'S LOCOMOTIVE SLIDE-VALVE.

I am sorry I cannot join with you in your commendations of your correspondent, "Helix Junior," for his having studied, in a careful manner, the article on "Locomotive Mechanism in the Great Exhibition." As far as I am concerned, he has certainly gone over it in rather a careless manner. He says I have inferred, "that because speeds are five times what they were, and that the working steam pressure is *doubled*, forty times the area of exhaust is now necessary to secure the same freedom of exit." Now, he will at once perceive, by referring to the article in question, that I was contrasting the low-pressure engine, using steam of 5 or 6lbs., with a high-pressure engine, requiring to exhaust steam of 100 lbs., a very different thing from the steam pressure being only doubled.

I may have expected opposition to the plan I have proposed, as in any alteration causing a considerable departure from any previously established arrangement, prejudice in favour of the old system is sure to raise its voice against it. But certainly I was not prepared to expect that the utility of the thing itself should be called in question. The many attempts which have been made by others, for the purpose of increasing the outlet for the steam, independent of other considerations, would have forbidden the idea. I have, and no doubt they also, have acted upon the *assumption*, that steam was an elastic body, but it seems —now that "Helix Junior" has come to enlighten us—we have all been quite mistaken. Well, it would no doubt be a great benefit, in as far as the high-pressure engine is concerned, if steam would only be so pliable as to retain its expansive qualities while in use in the cylinder, but, in making its exit therefrom, would here dispense with this undesired display of its properties. Perhaps "Helix" has discovered some mode of restraining this unfortunate propensity; if he had, his reasoning and calculations would be applicable to the question, but as it is, I need not say they are very absurd.

He tells us what all know—that the velocity of steam escaping into the atmosphere increases with the pressure, and has transcribed a series of pressures, with the velocities due to them. But he forgets a very important consideration—that to keep up those velocities, it is necessary that the *pressure* should also be kept up to the same; a *condition* this, he will perceive, not very favourable to the working of the engine. For it is not in consequence of any inherent property possessed by high-pressure steam that it does rush with those velocities into the atmosphere, but is caused only from the difference of pressure existing in the vessel containing it, and the atmosphere into which it is expelled.

He says, first, that I have assumed that the "old exhaust passages are just big enough." Now, the truth is, there was always a small per centage of loss, considered to arise from forcing the steam through the passages in low-pressure engines; and we find that, since more attention has been paid to the indicator diagrams, a considerable enlargement has been made in the passages of even those engines; which proves that the makers of those engines do not consider the passages any more than "just big enough."

But I am accused, secondly, of assuming "that the higher the pressure of steam to be exhausted, the greater, in the same proportion, is the force of exhaust." I have here assumed what I had considered was a well-known fact, and if "Helix Junior" had only given a little more attention to the few facts contained in his *own* communication to you, he would have found it fully borne out. Let us attend for a moment to the law which steam obeys in the process of exhaustion. If we have a vessel charged with steam, say of 100 lbs., and abstract one half of its volume, we leave no empty space, but have steam of 50 lbs. pressure instead; we repeat the process, and have steam of 25 lbs., and so on, until an equilibrium is established between the steam in the vessel, and the atmosphere or medium into which it discharges itself.

Now "Helix Junior" may at once perceive the fallacy of implying,

or asserting, that high-pressure steam exhausts in less time than low-pressure, as it must now, I should think, be apparent to him, that the steam of 100 lbs. must become 10 lbs., and even 1 lb. steam, before it can be fully exhausted. Such as I have now described is the only way in which steam will exhaust when left to itself, and if, in consequence of the smallness of the passages, conjointly with the velocity of the piston, time is not given for this, back pressure does, and must take place. And thus we may easily perceive, even from "general considerations," that the exhaust passages which may be ample enough for low pressure, are vastly too small and contracted for exhausting high-pressure steam.

The "mere absurdity," as "Helix Junior" terms it, of assigning 40 lbs. of back pressure to 100 lbs. of steam pressure, is not, however, founded on any calculation of mine, as he seems to have inferred, but is based upon the evidence of the indicator, to which he has advised me to appeal. This, then, shows me some narrow-guage engines, where the back pressure is close on 40 lbs. with 80 lbs. steam. What it would be if 100 lbs. steam had been used, I shall leave "Helix Junior" himself to infer, as I hope that *now* he will be a little more rational on this subject.

The case of the "Great Britain," Great Western Railway engine, undoubtedly shows, that everything there has been done that is possible with the ordinary slide-valve, consistent with other conditions, to lessen back pressure. But at the same time it proves to us how rapidly back pressure increases, as the pressure at which the steam to be discharged is elevated. I have not Clark's work at hand to refer to, but we may suppose the pressure at the end of the stroke, when cutting off, at 7 in. with 90 lbs. steam, to have been 20 lbs., which it could not exceed, when we take into account the opening of the exhaust port 5 or 6 inches before the termination of the stroke; and in the other case, when working with full steam, the pressure at the end of the stroke could not exceed 60 lbs., as, besides making allowance for the exhaust port opening before the termination of the stroke, we must also take into account that the steam will have been cut off about 6 inches from the end of the stroke. Now we find that in exhausting the 20 lbs. steam there is no back pressure. But in discharging the 60 lbs. steam, a back pressure is found to exist, equal to 10 lbs. I should have thought "Helix Junior" might have been rather astonished at this result. Certainly his preceding "considerations" on the subject would have led us to expect quite an opposite one, viz.—that the free exhaust would have been with the 60 lbs. steam, seeing it flies, as he describes it, with greater celerity before the piston, the velocity of which is also somewhat less; and the "practical obstruction"—which is the only thing that he refers to, as interfering with the correctness of his conclusions—if we are to attach any meaning to the words, is also in favour of the higher pressed steam.

I am glad, however, that in one point we can agree. In another portion of his communication, he seems to acknowledge the evil of the pressure on the back of the slide, and a mode for preventing a portion of that pressure, he characterizes as "being a step in the right direction." Now, the plan I have proposed accomplishes all this, besides affording a larger outlet for the steam, the want of which I consider the greater of the two evils attending the slide-valve, and this is accomplished without employing any means which, however feasible in theory, are either found to be impracticable, or useless in practice.

Swindon, Wilts, Nov. 1851. W. D. Sharp.

PHOTOGRAPHY ON GLASS.

Having lately had my attention drawn to the system of obtaining photographic pictures on glass, I was led, by the simplicity of the process, to make some experiments upon it, in the course of which I have succeeded in still further simplifying it. As it is highly probable that many of your readers are interested in this, as well as other branches of photography, I subjoin a description of my modifications. I shall, however, in the first place give a sketch of the mode of operating which I believe is generally adopted by amateurs as being the simplest, for the benefit of such of your readers as may be still unacquainted with this interesting and beautiful process. It is as follows:—Having precipitated an iodide of silver from a solution of its nitrate, by adding to it a solution of iodide of potassium, and well washed the precipitate in water, add to it a saturated solution of iodide of potassium till it is re-dissolved. A little of this solution of iodide of silver is then to be added gradually to collodion (a description of which is given below), and well shaken with it. After settling, this mixture is ready for use. Having procured a piece of plate-glass of the size required, pour over it some of the *iodized* collodion, allowing it to spread over the surface of the glass, so as to cover it completely, and then to flow off at one of the corners. After a little practice, this becomes very easy, and a fine even coating is obtained. The iodized plate is now to be immersed in a solution of nitrate of silver, 30 grains to the ounce of water, till the solution flows evenly over its surface, and it is then ready for the camera.

After removal from the camera, the picture is developed by pouring over it some of the following mixture:—

Pyro-gallic acid, - - - -	3 grs.
Glacial acetic acid, - - -	1 drm.
Water, - - - - -	1 oz.

When the picture is sufficiently developed, it is first washed with water, and then the sensitive coating is removed by means of a strong solution of hyposulphite of soda. It is then to be washed again with water, and when dry, a little thin varnish may be poured over it, to protect it from being rubbed off.

I now come to describe the modifications which I have adopted, and which I find not only simpler, but productive of a better result than can be obtained by the process which I have described.

The first of these relates to the iodized collodion, and was suggested by the idea, that it was unnecessary to add iodide of *silver* to the collodion, as the addition of iodide of potassium *alone*, on immersion in the nitrate of silver, would form the required coating of iodide of silver upon the glass. On trial I found this to be the case.

At this point it may be well to make some remarks regarding the preparation of the collodion, which is of so much importance in this process. It is made, as is now generally known, from gun cotton dissolved in sulphuric ether. There is, however, considerable difference in the mode of preparing the cotton for this purpose. I find the most certain mode of obtaining very soluble cotton, is to make use of nitre in place of nitric acid. Equal bulks of sulphuric acid and nitre will be found to answer very well. Let the cotton be immersed in this mixture, and well saturated with it for about seven or eight minutes; then let it be taken out and thoroughly washed in water, and dried.

We now arrive at the iodizing process, which may be simply effected thus:—To *pure* sulphuric ether add about ⅛ of its bulk of alchohol, then a little iodide of potassium, and after this the prepared cotton; let these be well shaken together for some time, and then allowed to settle. Four or five grains of iodide to the ounce of ether will be found sufficient.

The admixture of alchohol to the ether seems to be necessary in preparing collodion for our present purpose, as it will be found, if *pure* ether be employed, that little or no coating will be formed on immersion in the nitrate of silver. It must, at the same time, be observed, on the other hand, that when too much alchohol is added, the coating will be too opaque, preventing the light from penetrating. Thus, little more than the surface of the sensitive coating being acted upon, it is impossible to obtain a bold picture. It is difficult, by description, to point out the depth of coating required, but a very little experience will be sufficient to determine this. The object is to avoid the extremes above mentioned, viz., the having little or no coating at all, and the having a coating too opaque.

From the difficulty I have experienced in always obtaining *pure* ether, (there being often a considerable quantity of alcohol already mixed with it,) I have been obliged to adopt the following mode of preparing iodized collodion. To 1 oz. of ether add 5 or 6 grs. of iodide of potassium, and shake them well together for some time; after settling, the iodized ether should be poured off, and some of the prepared cotton added to it till the proper consistency is attained. Now, prepare a solution of iodide of potassium in alcohol, and add this to the iodized collodion till the coating formed by immersion in the silver solution is considered sufficiently deep. This should be of a milk-like appearance, but at the same time considerably transparent, for reasons before given. By this means, I am enabled, with ease, to modify my collodion so as to obtain any depth of coating I may desire; the only objection attending this *adulteration* being, the having to pay the price of ether for so much alcohol, which every one knows is considerably cheaper. My next modification is in the preparation of the developing mixture. It will be noticed that pyro-gallic acid is recommended for this purpose, the acetic acid being added to prevent the pyro-gallic from attacking the parts unaffected by light. This, in common with most other acids, it effects; but I have never been able by its use to obtain a pure white. From this circumstance, I was led to try the effects of other acids, and found nitric acid to answer my purpose. A difficulty, however, arose in the nice adjustment required in the proportions of the two acids, which induced me to try another well-known developing agent, sulphate of iron, and the result obtained in this way was quite satisfactory. The proportions in this case seem to be of much less importance, so that, with very little care, an excellent developing mixture may be obtained. I subjoin the proportions which I have used with success:—

Sulphate of iron,..................	12 grs.
Nitric acid,..........................	1 or 2 drops.
Water,..............................	1 oz.

If, from any variation in the strength of the nitric acid, the dark parts of the picture should be spoiled by the action of the sulphate, the addition of a little more acid will be found to prevent the evil.

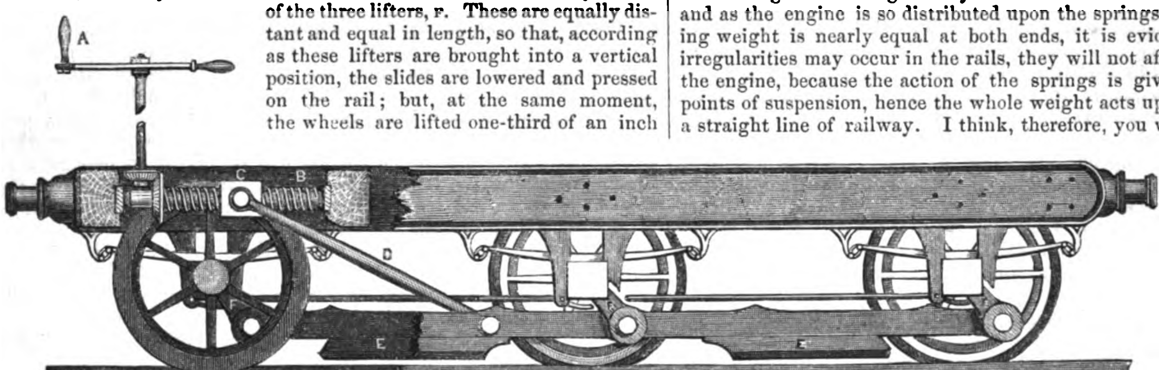
By means of the above modifications, I have obtained some excellent results; the whites of the picture being very pure, and of a fine metallic appearance, much resembling frosted silver.

Glasgow, November, 1851. H. R.

[We have before us some examples of our correspondent's productions, which possess an amount of brilliancy and boldness unknown in the ordinary Daguerreotype process. Few modern arts can be said to be in a state so essentially transitionary as Photography; but the introduction of collodionized glass seems to promise, in its results, to throw all previous inventions into the shade.—Ed. P. M. Journal.]

DILLON'S RAILWAY BRAKE.

Nothing in railway travelling is so important as the machinery used for stopping the trains, and as the plans now in use are very defective, I trust that the method which I propose will be worth consideration. The engraving represents the brake applied to an old carriage, a portion of the frame being cut away merely to show the nut and screw in their proper places. This brake differs from all others in this, that when it is applied, the tyre of the wheel is not in contact with the rail or anything else. When the guard is desirous of applying this brake, he has only to turn the handle, A, which, by means of the screw, B, and the nut, C, causes the connecting-rod, D, to move to the left; but the friction slides, E, being attached to the connecting-rod, they must move in the same direction, and they are also attached to the axles of the wheels by means of the three lifters, F. These are equally distant and equal in length, so that, according as these lifters are brought into a vertical position, the slides are lowered and pressed on the rail; but, at the same moment, the wheels are lifted one-third of an inch



off the rail, on account of the distance between the centre of the wheel and the bottom of the slide being one-third of an inch greater than the radius of the wheel. A great saving would be effected by adopting this method, there being no timber blocks required, and the wheels are not worn away by friction. The advantage in having the friction slides so large is, that if we distribute a certain weight over two square feet of surface, that surface will last much longer than if we were to put the same weight upon a square inch of surface, although the friction is *nearly* the same; therefore the repairs would be fewer than those attending the old plan of brake. The carriage is quite safe when this brake is applied, because the friction slides have flanges on their inner edge. A great saving is also effected by the wheels not being forced along the rail without turning on their axles.

Dublin, November, 1851. James Dillon.

[There is already more than one modification of this class of brake in existence. Mr. Bodmer, for example, patented an arrangement of skids in 1844.—Ed. P. M. Journal.]

THE "HAWTHORN" LOCOMOTIVE.

I observe in your *Journal* of last month, some comments by "Helix Junior," on the Locomotive Mechanism in the Great Exhibition, and as that gentleman appears to be ignorant of the principles of the parts he professes to criticise, I take the liberty of offering some remarks upon his production, in addition to those made in your own note.

First, "Helix Junior" states—"As to the mode adopted by Hawthorn for suspending the engine, his object is to equilibrate the load upon the wheels by compensating beams, so as to render the separate loads practically independent of irregularities in the rails. The object, I have no doubt, is perfectly accomplished so long as the engine is prevented from pitching. Now, it occurs to me that there is a great objection to the concentration of the suspended weight on four points so closely situated as to form a rectangle of suspension 7½ feet long by about 7 feet wide, whereas the total length of the engine, over the frame, is 24 feet, or three times the suspended length, and in locomotive engines the greater parts of the weight are distributed towards the ends; thus there is a powerful inducement, by the overhanging of these ponderous masses, to excessive pitching at high speeds, which, I apprehend, is the worst kind of instability."

"Helix Junior" forgets, in the plenitude of his wisdom, that the "Hawthorn" has not the tendency to pitch which is peculiar to the ordinary description of passenger engines; because in them the weight is suspended from six points or springs, and the greater portion of it is placed on the two centre points, or driving-wheels, to secure adhesion by tightening up the springs until they act like a fulcrum, upon which the principal portion of the weight of the engine rests—consequently, at high speeds, such ordinary engines will pitch on this fulcrum as on a pivot: whereas, in the "Hawthorn," the whole weight is distributed over the four points of suspension, according to "Helix Junior," 7½ feet by 7 feet; and by the arrangement of the beams and springs, half this weight is placed upon the driving-wheels for adhesion, whilst the wheels act upon the ends of the beams equidistant from the points of suspension as a fulcrum, and accommodate themselves to every irregularity in the rails, without sensibly disturbing the fulcrum, or points of suspension.

Now, the boiler, fire-box, and smoke-box together, do not exceed 17¾ feet in length, and as no part of the machinery extends beyond this, the whole weight of the engine may be assumed to be within these limits; and as the engine is so distributed upon the springs that the overhanging weight is nearly equal at both ends, it is evident that, whatever irregularities may occur in the rails, they will not affect the stability of the engine, because the action of the springs is given out at the four points of suspension, hence the whole weight acts upon them parallel to a straight line of railway. I think, therefore, you will agree with me in stating, that the "Hawthorn" is quite free from pitching, that "the object is perfectly accomplished," and that a most important addition is made to the safety of the public when travelling by railway. "Helix Junior" concludes this part of his production by stating, that "the objection becomes still more conspicuous when we reflect, that there is no practical advantage in so linking the three bearings on each side." He seems not to be aware that by "so linking" them, and a proper disposition of the springs, the weight would be transferred from the leading to the driving and trailing wheels, and *vice versa*. Take, for example, a six-wheeled engine, weighing twenty-four tons, and suppose there are ten tons on the leading, eight on the driving, and six on the trailing wheels—which is often the case—you will admit that the wear upon all the wheels will be irregular, and very detrimental to the proper working of the engine. The irregularity in the wearing of the wheels becomes very serious when coupled, because the difference in their diameter must be made up by slipping, and we consequently have an undue strain upon the coupling-rods, cranks, and axles, which often fractures them; but by applying Hawthorn's compensating beams and springs to such an engine as that last mentioned, with a proper disposition of the points of suspension, the weight can be distributed equally upon each wheel, thereby preventing the irregularity in the wearing of the wheels, and the serious consequences thereof. I think, when "Helix Junior" considers the foregoing, he will be satisfied that, instead of "the objection becoming more conspicuous," the advantages become quite apparent, at least to those familiar with locomotive mechanism.

"Helix Junior" further states—"In a four-wheel engine, we know (who are *we*?) the weight on each axle is invariable, and no adjustment of the springs can sensibly affect it."

Taking a four-wheeled engine, with the ordinary springs, he is quite right; but, for his edification, I may mention, that by using Hawthorn's compensating beams between the springs, and a proper adjustment of the fulcrum, the weight can be transferred from the one pair of wheels

to the other, as already described, whilst the elastic base remains the same.

The equilibrium slide-valves form the second portion of "Helix Junior's" observations; and looking at the approval bestowed upon them by him, the same must be peculiarly gratifying to Hawthorn.

"Helix Junior" states, thirdly—"As to Hawthorn's expansion link. Barring the method of the four eccentrics, which was a decided hit, Hawthorn has done little for the substantial improvement of the valve-gear, and what has he gained in the link before us? In the first place, he states that he lowers the boiler; but, by the drawing, the centre of the boiler stands 6½ feet off the rail, and if we take Hawthorn's own engine, published in the last edition of Tredgold, with a wheel 6 inches larger, the centre of the boiler is only 6 feet off the rail; or take Fairbairn's engine, as published in Clark's Railway Machinery, it stands just 6 feet 0½ inch from rail to centre of boiler, with a 5 feet 8 inches wheel; or take Wilson's engine, published in your own pages, the centre of the boiler stands just 6 feet off the rail, with a 6 feet driving-wheel; thus there is sensibly nothing to be claimed for the new link on the score of a low centre of gravity."

Now, any impartial person possessed of the requisite knowledge, in comparing the merits of the new expansion link, in lowering the centre of gravity, with those in use, would take the distance from the centre of the driving-axle to the under side of the boiler as the proper criterion; or rather from the centre of the expansion link, when out of gear, to the under side of the boiler; because the centre of the link is not always on the centre line of the axle and cylinders: for instance, in Wilson's engine referred to, the centre of the link and valve-spindle is 2¼ inches below the centre line of the cylinders and axle (which is very objectionable); hence, whilst the centre of the axle is only 13½ inches from the under side of the boiler, the centre of the link is 15¾ inches from the same; so that the distances from the centre of the link to the under side of the boiler, in the engine referred to by "Helix Junior," are as follow:—

Hawthorn's, published in Tredgold,.......... .. 6 inches.
The "Hawthorn," published in your *Journal*, 14½ inches.
Fairbairn's, published in Clark's work,.........14⅝ inches.
Wilson's, published in your *Journal*,...........15¾ inches.

The first of these engines has the eccentrics and expansion links outside the wheels, whilst the other three have them under the boiler. It would appear that "Helix Junior" did not know that this made any difference in the height of the boilers, when he referred to this engine as a comparison.

Fairbairn and Wilson's engines have the same kind of link with the eccentric rods attached to the ends, and the centres of the sliders when working full stroke are about 10 inches apart.

In Fairbairn's engine, the expansion link is 18¼ inches over the ends; extreme centres of sliders, 10 inches; hence there is ⅜ inch clearance between the top of the link and the boiler. Taking this as a datum for Hawthorn's patent expansion link, let us see how far "Helix Junior" is right in stating that "there is nothing to be claimed for the new link on the score of lowering the centre of gravity."

From the centre to the top of the new expansion link is 11⅜ inches—the ends of the eccentric rods being 9 inches apart, and not 8½ as stated by "Helix Junior"—clearance ⅜ inch; hence, from the centre of the link to the under side of the boiler is 11¾ inches, thus lowering the centre of gravity 2⅞ inches more than Fairbairn's, and 4 inches more than Wilson's engines—and the same proportion to all other engines using the ordinary link; and although "Helix Junior" considers this nothing, I am certain that you, and those of your readers conversant with railway machinery, will agree with me in stating that lowering the centre of gravity from 3 to 4 inches is of very great importance, and that Hawthorn was quite justified in stating that "he lowered the boiler." He further states, that "the proximity of the connection is the worst feature in the new link." I consider that this link will work better than those with the centres of the slides 10 inches apart; but suppose that we made the connection 10 inches, the boiler would still be lowered from 2½ to 3½ inches.

"The removal of the weight, in reversing, is a crumb of comfort, but we all know that the moving weight may be balanced." Yes, we all know that the moving weight may be balanced; we know, also, that the old fork-ended rods and rocking shafts might be used instead of the new expansion links; but we know further, that this is the age of improvement, and that Hawthorn has, by the invention of this link, in addition to the four eccentrics, completed the most mechanical, and, at the same time, the most effective reversing gear in present use; and that none but "Helix Junior" would resort to a balance-weight of about 112 lbs., when it could be advantageously dispensed with.

He further states, that "it has been overlooked, that the link may be, and is, in many valve motions suspended; and we have only the valve-rod link to remove in reversing; neither does this link yield a more perfect action of the valves. Pray, what is perfect action? I take it to mean—so far as link motions differ—that the lead is preserved constant for all grades of expansion, and that the steam is cut off equally for the front and back strokes of the piston. Now, with the new link, it is impossible to maintain a constant lead, for the lead increases with the expansion, and so far it is on a par with the ordinary shifting link. On the other hand, the stationary link, such as is employed on the Great Western Railway, preserves the lead constant, and so far it is superior to the new link. Moreover, in all links the same facilities exist for securing an equal cut-off for the two ends of the cylinder."

"Helix Junior" is not aware that the suspended link has been condemned and abandoned for the very reason he gives for its superiority, namely, preserving the lead constant during all grades of expansion. No doubt Hawthorn was aware of this when he discontinued its use; for I find a much better arrangement of the suspended link in their engine, published in the last edition of Tredgold, and referred to by "Helix Junior." I must say that it would have been much more creditable to his mechanical knowledge, had he referred to this as a specimen of the suspended link, instead of that used by the Great Western Railway Company, because Hawthorn's arrangement is much more mechanical, and the action more perfect, although possessed of the same fault as the other, in preserving the lead constant during all grades of expansion.

To show you that perfect action consists in increasing the lead with the expansion, I may mention that the best practice amongst railway engineers, is to give the slide-valves of fast passenger engines $\frac{3}{16}$ more lead than they give to those of goods engines; because they get a quicker exhaust, and the steam is admitted more rapidly at the commencement of the stroke, and they consequently have a more beneficial expansion of the steam. They are at the same time careful in adopting links that will increase the lead with the expansion. Thus, you see, "Helix Junior's" definition of "perfect action" is a fallacy, and the new link is superior (instead of inferior) to the suspended link; besides, it cuts off the steam equally for the front and back stroke of the piston, whilst the eccentric rods are the same length, and all the working points are on the centre line of the link, where they ought to be, and it works the engine equally well forward and backward. Now, let us see how far "Helix Junior's" favourite link complies with these conditions.

He has referred to Clark's "Railway Machinery," I would therefore direct your attention to the description of the suspended link given by the author of that work, and would only remark here, that Clark has committed the same error as "Helix Junior;" indeed, I think they must have had a consultation on the subject. He states, that "complete and perfect accuracy with respect to the distribution has, after some investigation, been accomplished. As especially arranged for the "Great Britain," the back eccentric rods are made a half inch longer than the fore rods," &c. The points at which the rod-ends are attached are 3 inches from the centre of the expansion link, the suspending links are 1¼ inch from the centre line of the same, and 1½ inch below the centre line of motion, and the reversing link is attached to the slide-rod link 8 inches from the end, or from the centre of the expansion link. The working points have each a different position, and instead of being on the centre line of the expansion link, they are above, below, and on either side, without any definite rule to guide them; and I defy any man to find out the proper position for them, but in the manner it has been done for the link in question, namely, by making, altering, cutting up, and trying it, until they arrived at something near the mark for the forward gear—a mode of procedure which would not be tolerated by any person possessing a knowledge of the elements of mechanics. Indeed, the motion of this link is so notorious, that it has got the name of the "rolling link,"—in fact it has not a good point to recommend it; yet "Helix Junior" and Clark have been at great pains to make us believe it to be the quintessence of perfection; and after all their trouble, it only works nearly correct for the forward gear, and in doing this, the sliders work up and down in the links from 1¼ to 1½ inch, and the steam is *not* cut off equally on each side of the piston, as stated by these gentlemen; hence the same facilities do *not* exist in all links for securing an equal cut-off for the two ends of the cylinders. To satisfy you on this point, examine the Great Western engines at work with this link.

The advantages of the new expansion link I conceive to be as follows, namely, it increases the lead with the expansion; it works the engine equally well backward and forward; it lowers the centre of gravity of the engine from 3 to 4 inches; it admits of the stroke of the eccentrics being the same as that for the slide-valves; whilst in Fairbairn's and Wilson's engines, mentioned by "Helix Junior," the stroke of the eccentrics must be from 1 to 1½ inch more than the stroke of the valves; the slides are about four times the length of those in the ordinary links,

and, consequently, will wear so much longer, and the weight of the rods only has to be moved in reversing, which is of great importance when changing the motion of the engine in a hurry, and the steam partially on.

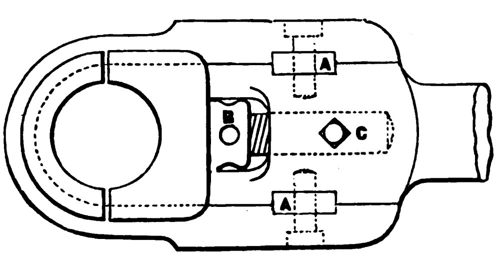
Allow me to conclude this paper—which has already run to too great a length—by expressing my conviction, that "Helix Junior" would have rendered more benefit to himself at least, if not to your readers—did he determine on continuing one of your correspondents—were he to make himself more practically acquainted with the elements of engineering than his late production proves him to be, and in which every one venturing to enlighten the public on the intricate subject of the "Locomotive Mechanism of the Great Exhibition," ought to be, before he attempts such a task.

November, 1851. JUSTITIA.

HUMPHREY'S CONNECTING-ROD END.

The accompanying plan of connecting-rod end, or butt, may perhaps find a place in your pages, as a useful contrivance in cases where there is no room for the ordinary arrangement. In inside cylinder locomotives particularly, the centre of gravity of the engine may be lowered some inches by its instrumentality in saving the vertical space occupied by the projecting ends of the keys commonly employed.

The strap is secured by the keys, A, let half into the strap, and half into the sides of the head, and fixed by counter sunk set-screws, passed through them into the head. The back brass is tightened by the capstan-headed screw, B, tapped into the head, and secured laterally by a set-screw, C, whilst a steel plate is let into the back of the brass for the bearing of the screw head, B. I have a pair of these ends fitted up and at work, and find them to answer most satisfactorily.



1-4th.

London, *November*, 1851. J. D. HUMPHREYS.

[This is a very neat form of connecting-rod end; whilst it is of great strength, and presents what a mechanic would call a clean appearance, all projections being avoided in it.—ED. P. M. JOURNAL.]

ROTATION OF THE EARTH.

Whilst thanking you for the manner in which you have allowed me to speak, through the columns of your *Journal*, in September last, I must beg permission to say something in reply to the observations of "O. T." in your last issue. In my former note, I was deterred by the staleness of the subject, and the liability of being tedious, from giving the particulars of my plan in very full detail. I may now explain that my mode of placing the working beam on its resting-place is this:—The beam is suspended at its centre of gravity by a floating swivel, in *nearly* a vertical position, and its upper end is tied by a fine cord to prevent its descending, whilst two weights of different magnitudes are placed on its two ends—the heavier one being aloft—and the whole being placed so as to descend as near as possible vertically, if we wish it to be finally stationary. The cord is now burnt, and when an impulse sufficient to carry the beam to the horizontal position has been communicated, a stage, similar to that in Atwood's machine, is placed to intercept the heavier weight. When the second oscillation is just commencing, the lighter weight is intercepted in a nearly similar way, and the beam is then lowered to its supporting pivot. In aiming at a stationary position, I first thought the vertical to be the best, as the only direction that could give a motionless beam; but on considering the point more at length, it appears that any other direction will answer as well, provided the upper end descends on a point of the *north* semicircle, and that, as the greatest attainable velocity is desirable, the meridian is preferable to any other, as giving that velocity. Any one with a tithe of "O. T.'s" perspicacity, will at once see the chain of reasoning throughout the process.

The floating swivel may be constructed just as in the main apparatus, only that it need not be so accurately finished, nor so large, as it is to be so short a time in action. If it merely floats the loaded beam, it is enough.

Dunfermline, *Nov.*, 1851. J. B.

INSTITUTION OF CIVIL ENGINEERS.

SIR WILLIAM CUBITT, PRESIDENT, IN THE CHAIR.

NOVEMBER 11, 1851.

"On an Investigation of the Strains upon the Diagonals of Lattice-beams, with the resulting Formulæ," by Mr. W. T. Doyne, Assoc. Inst. C.E., and Professor W. B. Blood.

The experiments detailed in the paper were made on a model 12 feet in length, so constructed that the diagonals in compression, which were strips of mahogany let into the top and bottom, but not fastened to them, and the ties, which were of hoop-iron chains, must of necessity take their respective bearing and strain, and by the substitution of a dynamometer for any one of the ties, the strain on it could be accurately measured.

The results of the investigation, which were given in a table, showing a remarkable coincidence between the strains as measured and calculated, were, that for a parallel beam of one span, supported at each end and loaded at the centre, the strains throughout the diagonals were uniform, and the horizontal strains were greatest at the centre, decreasing uniformly at the points of support.

For a similar beam, uniformly loaded over its entire length, the strains on the diagonals commenced at the centre, increasing uniformly to the points of support, while the horizontal strains decreased from the centre to the ends, in the ratio of the ordinates of a parabola.

These results were arrived at by different methods of reasoning, and the formulæ derived from them were stated to be applicable to the more complex form of a closely intersected lattice, taking into consideration the increased number of triangulations.

The paper then proceeded to show, that the same reasoning might be applied to beams with solid sides, and their proportions calculated accordingly.

As a practical illustration of this principle, the author exhibited a drawing of the Glyn Taff viaduct, constructed by him for the Aberdare Iron Company, in which the main bay over the river Taff was 140 feet span, and the weight of iron-work 53 tons. This bridge was capable of carrying a constant load of 73 tons, and the weight necessary to break it was calculated at 359 tons.

In an appendix, the formulæ were extended to the cases of beams fixed at one end only, and also to those having several points of support; in the latter case, it appeared that the greatest possible strain due to a moving load upon the diagonals at the centre, was only one-fourth that at the points of support, where the bridge was of one span only; and when there was more than one span, that a portion of the value of continuity was lost in the case of a moving load, in consequence of the point of contrary flexure changing its position.

The paper was illustrated by diagrams, and the experiments upon the model were explained by the author.

The President recalled to those gentlemen who had been recently elected, the engagement entered into on their election, to present original communications, books, &c., in order to promote the interest of the meetings, or increase the library.

The Council have awarded the following premiums:—

1. A Telford Medal, in silver, to Samuel Clegg, jun., M. Inst. C. E., for his paper "On Foundations, Natural and Artificial."
2. A Telford Medal, in silver, to Matthew Digby Wyatt, Assoc. Inst. C. E., for his paper "On the Construction of the Building for the Exhibition of the Works of Industry of all Nations in 1851."
3. A Telford Medal, in silver, to Henry Swinburne, for his paper, "Account of the Sea Walls at Penmaen Mawr, on the line of the Chester and Holyhead Railway."
4. A Telford Medal, in silver, to George Barclay Bruce, M. Inst. C. E., for his paper, "Description of the Bridge built over the River Tweed, on the line of the York, Newcastle, and Berwick Railway."
5. A Telford Medal, in silver, to John Hughes, Assoc. Inst. C. E., for his paper "On the Pneumatic Method adopted in Constructing the Foundations of the new Bridge across the Medway, at Rochester."
6. A Telford Medal, in silver, to William Price Struvé, M. Inst. C. E., for his paper "On the Ventilation of Collieries, theoretically and practically considered."
7. A Telford Medal, in silver, to Alfred Vincent Newton, for his paper, "An Inquiry into the nature of Patent Law Protection, with a view to the better appreciation and security of the Inventor's rights."
8. A Council Premium of Books, suitably bound and incribed, to Joseph Glynn, M. Inst. C. E., for his paper "On the Isthmus of Suez, and the Canals of Egypt."
9. A Council Premium of Books, suitably bound and inscribed, to Thomas Evans Blackwell, M. Inst. C. E., for his paper, "Results of a series of Practical Experiments on the Discharge of Water by Overfalls."
10. A Council Premium of Books, suitably bound and inscribed, to James Leslie, M. Inst. C. E., for his paper, "Proposal for a mode of Computation, whereby Floodwater may be excluded from a set of Gaugings."
11. A Council Premium of Books, suitably bound and inscribed, to Henry Car, Assoc. Inst. C. E., for the Drawings illustrating his paper, "Description of two Bridges over the River Don and Canal, &c., at Sprotbro', near Doncaster."

We may here remind our readers, that the Council invite communications on the following, as well as other subjects, for premiums:—

1. A general investigation of the laws of the flux and reflux of the tide in estuaries.
2. On the principles upon which the works for the improvement of river navi-

gation should be conducted, and the effects of the works upon the drainage and irrigation of the district.

3. The improvement and maintenance of natural or artificial harbours: the most efficient means of clearing away deposits by the use of backwater, or by directing the natural currents.

4. The selection of sites for, and the principles of, the construction of breakwaters, and of harbours of refuge; illustrated by examples of existing works.

5. The forms and construction of piers, moles, or breakwaters (whether solid or on arches), sea walls, and shore defences; illustrated by examples of known constructions, such as the Cobb wall at Lyme-Regis, &c.

6. The best system of forming artificial foundations, showing the ratio of pressure to surface, and the soil best calculated to sustain heavy structures; illustrated by the best examples in modern practice, and by accounts of the failures of large works.

7. On brick and tile making, and the capability of introducing new forms for engineering and architectural purposes. With the processes most useful to emigrants and settlers.

8. On the application of wrought-iron, on a large scale, to engineering and architectural structures.

9. Accounts of experiments on the strength of metal trusses and columns used in buildings.

10. Improvements in the construction of girder bridges, whether of trussed timber, of cast-iron, trussed or plain, or of hollow wrought-iron beams.

11. The construction of suspension bridges with rigid platforms, and the modes of anchoring the stay chains.

12. The comparative advantages of iron and wood, or of both materials combined, for the construction of steam vessels, with drawings and descriptions; the methods for preventing corrosion; and details of the arrangements for the compasses in iron ships.

13. On the changes that have been introduced within the last fifteen years, in the lines of ships and steam vessels; and an examination of the effects produced by the new law of measurement for tonnage.

14. The best method of external condensation, so as to permit the employment of salt or of hard water, and furnishing pure water for the boiler. With a description of various systems of evaporating, refrigerating, &c.

15. The results of the use of tubular boilers, and of steam at an increased pressure, for marine and other engines; and of the most successful means for avoiding smoke in furnaces of all descriptions.

16. The application of the principle of expansion to the improvement of steam-engines for producing rotatory motion.

17. On the application of steam power to canal navigation.

18. The economy of railways as a means of transit, comprising the classification of the traffic, in relation to the most appropriate speeds for the conveyance of passengers and merchandise.

19. The arrangement and distribution of the workshops at the principal repairing station of a railway, for the repairs and maintenance of the locomotives, passenger and other carriages, &c.

20. The construction of locomotive engines, specially adapted for steep inclines; with accounts of experiments demonstrating the comparative value of large and small engines, under various circumstances.

21. Improvements in the construction of railway carriages and waggons, with a view to the reduction of the gross weight of passenger trains. Also of railway wheels, axles, bearings, and brakes; treating particularly their ascertained duration and their relative friction.

22. The construction and duration of the permanent way of railways in Europe, and the modifications most suitable for India, Egypt, &c.

23. Railway accidents; their cause, and means of prevention. Detailing particularly the various contrivances which are in use, and have been proposed, with the regulations of some of the principal lines.

24. The electric telegraph; the several improvements in its construction, particularly as regards the insulation of the wires, and the various uses to which it has been applied.

25. The results of experiments for obtaining motive power through the agency of galvanism.

26. The results of experiments made with various dynamometers, for the purpose of ascertaining the different ratios between power and effect in machinery generally.

27. The conveyance and distribution of water in towns; the sources from whence it may be derived; a description of the different modes of collecting and filtering; and an account of the advantages or disadvantages of the high service constant supply system.

28. The drainage and sewerage of large towns; exemplified by accounts of the system at present pursued, with regard to the level and position of the outfall, the form and dimensions of the sewers, the prevention of emanations from them, the disposal of the sewerage, and of the arrangements for connecting the house drains with the public sewers.

29. On warming and ventilating buildings.

30. Improvements in the system of lighting by gas; the results of the use of clay retorts—of large ovens (for producing a better quality of coke)—of exhausters, condensers, and modes of purifying, and the precautions for the economical distribution of gas.

31. A mathematical or geometrical demonstration of the advantages of flat sails for ships, over those of different degrees of curvature, when exposed to direct and slanting winds.

32. On the application of machinery, combined with mechanical power, and the means of transporting manure and produce on large farms and agricultural establishments; and on improvements in the plan of the works and buildings, and the "plant" employed.

33. The most effective arrangement and form of centrifugal and reciprocating blowing apparatus.

34. Description of cast or wrought-iron cranes, scaffolding, and machinery, employed in large works, in stone quarries, &c., especially where steam is used as a motive power.

35. On the improvements which may be effected in the buildings, machinery, and apparatus for producing sugar from the cane, in the plantations and sugar works of the British colonies, and the comparison with beet-root, with regard to quantity, quality, and economy of manufacture.

36. Description of the machinery adapted for the preparation of Indian cotton.

37. Improvements in flax machinery, and in the processes for preparing the flax for manipulation.

38. Notice of the principal self-acting tools employed in the manufacture of engines and machines; also of moulding machines and wood-working machines; and the effect of their introduction.

39. On the best system of remedying the inconvenience resulting from the present want of uniformity between the weights, measures, and coins of the different countries of Europe.

40. Memoirs and accounts of the works and inventions of any of the following engineers:—Sir Hugh Middleton, Arthur Woolfe, Jonathan Hornblower, Richard Trevithick, William Murdoch (of Soho), and Alexander Nimmo. Original papers, reports, or designs, of these or other eminent individuals, are particularly valuable for the library of the Institution.

The communications must be forwarded, on or before the 30th of March, 1852, to the house of the Institution, No. 25 Great George Street, Westminster.

ZOOLOGICAL SOCIETY.

TUESDAY, NOV. 11.

MR. BRODERIP IN THE CHAIR.

Professor Owen opened the session, by speaking, as his wont is, rather than by reading, a paper on the relative capacities of the cranium of man, the great chimpanzee, and the oran-otan. He began by referring to the mode originally devised by Camper, in his facial angle, of ascertaining the gradation of the different varieties of the human species, and by demonstrating the errors which attach to it. He said that, through the kindness of the members of the Philosophical Society of Bristol, he had been permitted to make sections of various crania in their possession, and which had been transmitted to him for the purpose. He had compared these sections, particularly those which illustrated the papuan (Australian), or lower race of mankind, and the gorilla (great chimpanzee), or highest type of the quadrumana, and had observed many and very great differences in structure, some of which were pointed out on the crania. These differences can only be attributed to difference in species, and by no rule or process of construction known can they be considered as contributing to the doctrine of transmutation of species; notwithstanding one singular fact established by his comparisons, viz., that in the papuan, the frontal and contiguous sinuses were absent, as in the gorilla and the inferior races of mammalia. As the result of his present labours, he exhibited the following diagram, showing the mean capacity of cranium in cubic inches:—

Caucasian (English),		96
Malayan,		86
Ethiopian	African	82
	Australian	75
Gorilla (the great chimpanzee),		30
Oran-otan,		28

INSTITUTION OF MECHANICAL ENGINEERS.

JULY 30, 1851.

"Siemens' Regenerative Condenser"—continued from page 190, *ante*.

The two condensers are cast in one piece, and placed immediately in front of the cylinders of the engine. Each of them closely resembles the condensers above described; only the length of the plates, and the stroke of the displacing pistons, are much reduced in proportion to the steam cylinder, in order that the velocity of the water between the plates may not exceed certain limits.

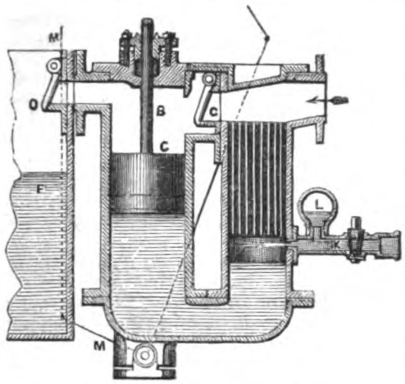
The two displacing pistons are connected to opposite ends of a short vibrating beam, which receives its motion from the engine.

In addition to the exhaust valves leading into the hot well, these condensers are provided with a second set of discharge valves, of a somewhat peculiar construction, which, with very limited motion, combine the advantage of opening a perfectly clear passage for the exhaust steam of the engine into the chimney, where its remaining expansive force is required to produce draught. This valve consists of a longitudinal rectangular slot in the upper wall of the steam passage which leads from the cylinder to the condenser. At the ends of the slots are triangular pieces, which support the sides of two longitudinal lips which cover the aperture, except at such times when a superior pressure from within forces them open. The extent of their motion is limited by dead stops.

The escape of steam, together with the hot water, into the hot-well, is regulated by a blow-off valve from the latter into the atmosphere; by this means a pressure above that of the atmosphere is obtained in the hot well, which acts favourably in forcing the boiling-hot condensing water into the feed-pump of the boiler. It has been stated above, that the ordinary supply of feed-water is of itself not quite half sufficient to maintain a vacuum within the condenser, and an additional supply of water must be provided for. Considering, however, the smallness of the excess of

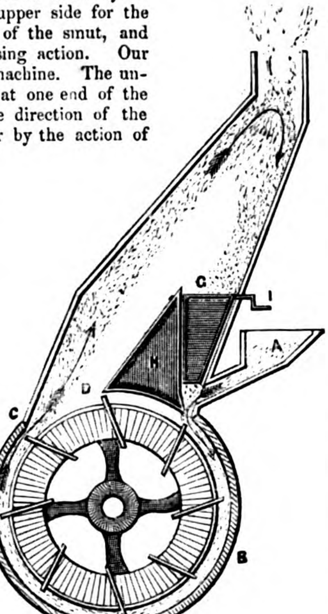
condensing water, especially if the diameters of the working cylinders are reduced in proportion to the additional effective power gained, and considering that boiling-hot water will readily part with the principal portion of its heat, it is proposed to take it back to the tender through a simple refrigerator, in which advantage is taken of the rapid motion of the engine through the air for cooling the water. The refrigerator may be placed conveniently on the back of the tender.

The annexed application of the proposed condenser to low-pressure engines requires but a short notice, after what has been said already. In it the steam, at the time when it is released from the cylinder, has not sufficient force to expel the air and heated water from the condenser into the atmosphere, and a partially vacuous space must be provided for their reception. For this purpose, that side, B, of the displacing cylinder which, in the arrangement hitherto described, is always empty, is put in communication with the exhaust valve, G, of the condenser, and receives the charge of water and air at the time when the piston, C, is at the opposite end. A second valve, O, is provided, through which the water is expelled into the hot well, F, during the return of the piston. For the convenience of arrangement, the displacing cylinder is reversed. K and L are the regulating cock and air-vessel.



MONTHLY NOTES.

Hollingsworth's American Smut Machine.—An effective machine for cleansing wheat from smut, has been patented during the present year, in America, by Mr. J. Hollingsworth of Yanesville, Ohio. It consists of a horizontal metal cylinder, having a wide opening along its upper side for the entry of the wheat, and the discharge of the smut, and fitted with a beater shaft for the cleansing action. Our engraving is a vertical section of the machine. The uncleansed grain enters by the hopper, A, at one end of the cylinder, whence it passes down in the direction of the arrow, and is scoured round the cylinder by the action of the beater, which revolves within it, at the rate of 400 revolutions per minute. The cylinder is open at both ends, to admit air freely to carry off the light foreign matters. When the grain has been carried rapidly round the cylinder to the part, C, the centrifugal force forces it up through the opening, D, right through the chimney above, until overcome by the force of gravity, it falls again into the cylinder to be again scoured, whilst the smut, dirt, and chaff, are blown out at the top mouth. This process is obviously repeated at each revolution of the beater shaft, and the grain is scoured more or less as may be necessary, by means of a number of aprons, G, at the back of the chimney, behind the triangular division, H. The aprons are moveable, each being set on a wire, to be worked by external cranks, I, so that any desired inclination may be given to them—the set in one direction being for the longer retention of the grain in the cylinder, and in the other an earlier discharge. The cleansed grain, gradually finding its way to the opposite end of the cylinder, is discharged by a spout at the bottom.



M. Sisco's Improved Chain Cable.—This new form of cable, on which experiments have just been tried at H. M. Dockyard, Woolwich, is composed of links made of common hoop-iron of the required breadth, wound on a reel by machinery into an oval shape, and to the same breadth as the outer surface, which is rounded off, after the whole has been brazed, by passing through a furnace of molten metal. The usual test of an iron chain for naval service, with links of two inches diameter, is 72 tons, many links breaking with much less strain, whilst the rest of the parts pass the test. M. Sisco's chain of two inches broad and two inches thick, with stays in the centre of each of the two links, was placed in the testing-frame, attached to a testing-chain of 2½ inches in diameter, and on the hydraulic power being applied, one of the links was lengthened five-eighths of an inch, and the other one-eighth of an inch, when it reached a strain of 110 tons, and the 2½ inch testing-chain broke off in two places when the strain reached 114 tons. The hoop-iron chain had some openings in one of the links, which had been imperfectly brazed, but it did not appear to have been made otherwise defective. One link of the same dimensions, two inches thick, and two inches broad, was afterwards placed in the testing-frame, and when a strain of 70 tons was applied it had lengthened one-twelfth of an inch; with 80 tons, one-eighth of an inch; with 100 tons, three-sixteenths; with 110 tons, one-fourth of an inch; with 115 tons, five-sixteenths; and when it resisted 120 tons strain, it was considered advisable not to continue the strain, as it was so great as to loosen the stone frame on which the machine rested. This strain exceeded all previous tests by one ton, and the hoop chain was only slightly opened on one side. The chain is said to be no more costly than the common kind, although so much stronger. So far back as 1812, Mr. Addenbrooke of the Broodwater Works, Kidderminster, submitted a chain of the same kind to the Admiralty, his attention having been drawn to it, from the great strength of the tyre-iron used for mail coaches.

Magnetic Water-Guage for Boilers.—A simple water-guage, in which the connection between the float and the external index is produced by magnetism, has been recently invented by Mr. G. Faber of Canton, Ohio, U.S. In general appearance it resembles the ordinary ball-float apparatus for water cisterns, a hollow copper sphere being attached to the end of a brass rod, the other end of which is cranked, and passes through a journal terminating in a circular plate. The end of the rod extends beyond the plate, and has on it a steel magnet, with positive and negative poles; whilst outside the plate, a cap is screwed on to form a chamber for the working of the magnet, and on the front of the cap is a recess for the steel index needle, carried on a central pin, and covered by a glass shade. In setting this apparatus to work, a hole is drilled through the boiler end at about the height of the usual central guage cock; and through this hole is passed the stem or pipe to which the index is attached, and fixed in position by a set nut on the inside. The float is then screwed on the lever, and the dial is adjusted so that the needle is horizontal when the water is at the proper working height. It is obvious that all variations of the angle of the float lever will cause corresponding variations of the index needle, which is turned upon its centre as the magnet moves, and thus no stuffing-box or other connection is required.

Iron Scaling Ladders for the Army.—Some time since,* a Birmingham correspondent pointed out the importance of adopting iron ladders for mining purposes, and we perceive that the idea has since been taken up by the Government authorities in reference to scaling ladders for the army. The subject was brought forward under the auspices of a number of the officers of the Royal Engineers, and other officers in the East India Company's Service, who made trial of six different kinds of ladders, in a ditch in the Chatham fortifications. Of these six, the first was the old wooden kind; the second and third, also of wood, were the inventions of Major-General Pasley and Colonel Blanchard respectively; the fourth and fifth were of iron, on the plan of Captain Addison; and the sixth was from the Royal Arsenal, Woolwich. One of Captain Addison's ladders is formed of wrought-iron circular tubes, and the interior filled with wood two inches in diameter and eight feet long; the other is made of wood, with an iron band along the outside. The ladder from the Royal Arsenal is made of wrought-iron tube in an oval form, and when the parts are separated, the cross-bars or steps, also made of wrought-iron tubes, can be all placed inside the supports. Captain Addison's tubular ladder has the cross-bars placed outside the tubes, and moving on pivots, the two supports, adjusted when in use by two diagonal bars on the other side, can be made, by loosening the two diagonal bars, to lie close to each other, and occupy very little room. The ladder is formed of three pieces, the middle tube being smaller than the lower, and the upper smaller than the middle, and are as easily and quickly joined as the lower parts of a fishing-rod. The wooden ladders consist of one of two pieces, one of three pieces, and one of four pieces, but their steps are fixed, and cannot allow the supports to be placed close to each other, as in the two iron ladders. The experiments commenced by Sergeant-Major Allen selecting six parties of six men each from the Royal Sappers and Miners at Brompton Barracks, having each party as nearly similar in size and strength of the men as possible, and they proceeded to the ditch. During several trials, the circular tube ladders of Captain Addison were put together and let down into the ditch about twenty feet deep, and the men descended on it in less time than by the others. The ladders were also taken down into the bottom of the ditch and raised to the other side, and the wall scaled several times with the greatest activity by the men on all the ladders, with the exception of the oval tubular ladder, which, being of equal dimensions throughout its entire length, the six men employed could not raise it against the wall of the ditch, and it required four men extra to raise it when it was taken out of the ditch on the experiments being concluded. The only objection to Captain Addison's tubular ladder was the difficulty of drawing it up out of the ditch after the wall had been scaled, owing to the projection of the diagonal bars on the back; but Captain M'Kerlie suggested the expediency of these bars being made to move inside, and Mr. Webb, blacksmith, Woolwich, who attended on Captain Addison, was detained at Chatham to have that alteration effected.

On Augmenting the Ascending Power of Locomotives on Steep Inclines.—Mr. Ellwood Morris, the American engineer, proposes to increase the bite, or tractive adhesion of locomotive driving-wheels on inclines, by laying down broader rails at those parts. The existing surface contact does not exceed two inches, whilst the wheel tyres have a breadth of about four inches. He would therefore take advantage of this superior breadth, by laying down, where necessary, rails of the same bearing width, made to suit the contour of the tyres. This suggestion is certainly a very practicable one, and if carried out, would doubtless greatly assist engines on lines like the Caledonian, where the gradients are both long and steep.

* Page 18, Vol. II., Practical Mechanic's Journal.

Galvanised or Copper-Faced Types.—This American invention, to which we have before alluded,* appears to be gaining a gradual introduction amongst the printers of the United States. The body of the type is of the ordinary metal, but the admirably sharp face is given to it by an electro-deposit of copper, which Dr. Newton, the inventor, has practically found to be better suited for printing than any other material of which types are usually made. As an example of the important superiority in the wear of copper, it may be mentioned that common type which would only stand at the head line of a newspaper—the *American Messenger*—through a single edition of 170,000 impressions, when replaced by the copper-faced type, lasted for six editions of the same number, and even then was not quite worn out. The *New York Courier and Enquirer*, the *Boston Daily Journal*, and numerous other newspapers, are now printed from this type, with very great improvement in the typographical effect. The additional cost, compared to the common type, is about 30 per cent. The printers who have tried the new kind invariably prefer it, from the greater ease of setting up, owing to the distinguishing feature of the copper face. Besides this, less ink is required on the rollers, and less on the type face, and waste is consequently diminished, with a manifest improvement in the impression.

The Holyhead Steamers.—The most successful effort at producing fast steamers has resulted from the competition which the Board of Admiralty induced for separate designs for four steam-packets, to occupy the station between Holyhead and Kingstown. The four constructors who submitted plans for these vessels were Sir William Symonds, for the *Caradoc;* Mr. Oliver Wm. Lang, of Chatham dock-yard, for the *Banshee;* Messrs. Miller and Ravenhill, for the *Llewellyn;* and Mr. John Laird of Birkenhead, for the *St. Columba.* The following table states the principal dimensions of these vessels, and also some other information, showing their active and relative capabilities of speed.

PARTICULARS.	Caradoc.	Banshee.	Llewellyn.	St. Columba.
	ft. in.	ft. in.	ft. in.	ft. in.
Length between perpendiculars,	193 0	189 0	190 0	198 6½
Breadth of vessel,	26 9	27 2	26 6	27 8
Breadth over paddle-boxes,	...	49 6	...	43 6
Depth in hold,	14 9	14 9	...	15 5
Draught of water, forward,	...	8 10	...	9 2
Draught of water, aft,	...	9 2	...	8 7½
Light displacement in tons,	260	270	323	272
Burthen in tons,	662	670	654	719
Diameter of paddle-wheels,	25 6	25 0	30 0	28 0
Nominal horse-power of engines,	350	350	350	350
Diameter of cylinder in inches,	74	72	68	70
Length of stroke,	6 0	5 6	4 4	5 6
Revolutions per minute,	28	30	27	25½
Breadth of paddle-wheel,	8 0	9 0	8 6	6 0
Dip of paddle-wheel,	...	5 6½	...	5 6½
Area of paddle-wheel,	...	33 9	30 10½	27 0
Area of the midship section,	...	190 0	...	...
	h. m. s.	h. m. s.	h. m. s.	h. m. s.
Time occupied in making the shortest passage between Holyhead and Kingstown, from the 1st Aug. to the 31st Dec. 1848,	4 0 0	3 26 0	3 41 0	3 56 0
Rate in knots per hour,	14·0	16·32	15·2	14·23
Rate in miles per hour,	16·13	18·80	17·5	16·37
Time of longest passage,	5 52 0	5 23 0	5 28 0	6 23 0
Rate in knots per hour,	9·5	10·4	10·24	8·77
Rate in miles per hour,	10·94	12·0	11·79	10·10
Average time of passage,	4 30 0	4 2 48	4 15 30	4 38 48
Rate in knots per hour,	12·45	13·84	13·10	12·05
Rate in miles per hour,	14·34	15·95	15·10	13·00
	lbs.	lbs.	lbs.	lbs.
Pressure on the safety-valve,	14	14	20	14
	h. m. s.	h. m. s.	h. m. s.	h. m. s.
Time of making the shortest passage, from 1st Jan. to 1st March, 1849,	3 59 0	3 36 0	3 37 0	4 8 0
Time of longest passage,	5 16 0	7 43 †0	4 50 0	6 30 0
Average time of passage in 1848-9,	4 31 25	4 3 8	4 9 30	4 40 42
Shortest time of passage, from 1st Aug. to 1st Oct. 1849,	3 54 0	3 26 0	3 36 0	4 3 0
Average time of passage, from 1st Aug. to 1st Oct. 1849,	4 26 0	4 3 0	4 6 0	4 40 0

The ordinary performances of these four packets, as well as their performances, especially under trial, have determined their relative merits. Their service is one that demands at all times the greatest effort that can be made; and therefore it is no doubt quite fair to conclude that they have done all that they are capable of doing, and that the following order of merit is strictly correct: *Banshee*, first; *Llewellyn*, second; *Caradoc*, third; *St. Columba*, fourth. It will be observed that the pressure of steam kept up was the same (14 lbs on the valve), in all except the *Llewellyn*, in which it was 20 lbs. Sufficient time has elapsed to sanction the inference thus drawn of relative excellence as to speed, whilst there is no doubt that each of them bears a character of very high order.—Fincham.

Preservation of Iron Ships' Bottoms.—Mr. Hay's composition for the preservation of iron ships' bottoms has now had an extended trial, sufficiently satisfactory to induce all owners of iron vessels to adopt the plan at once. The *Fairy*, H. M. screw-tender, has been coated with it since the early part of 1847, with the exception of about three months, when she had one side treated with Mr. Peacock's composition to test the relative values of the two.‡ The result of that experiment was conclusive in proving the superiority of Mr. Hay's invention, the port side coated by that gentleman presenting a perfectly clean appearance, whilst numerous weeds adhered to the starboard side. In reference to this subject, the *Port of Portsmouth Guardian* remarks, that "public attention has recently been called to the merits of the different compositions now in use for ships' bottoms, in consequence of an erroneous statement having appeared in the *Times*, wherein it was stated that Peacock's composition had been applied to the bottom of the *Fairy* instead of Mr. Hay's. From a letter which has appeared in the *Herald*, we find the *Times*, unwilling to contradict itself, has turned a deaf ear to Mr. Hay's very reasonable request to publish a statement of facts. We have paid some attention to the effect of the application of the various compositions, and have no hesitation in pronouncing Mr. Hay's to be superior to any other, as will be borne out even in the statement of the *Times* itself, by merely transposing the names, and reading Hay for Peacock. The bottom of the *Fairy* has now been scraped in order to be coated with Peacock's composition, but the removal of Mr. Hay's was a most difficult task. and occupied upwards of twenty men three days. If further proof were required of the difficulty of removing Hay's composition when on, we will mention, that some time since, when the bottom of the *Sharpshooter* underwent some repairs at Malta, it took ten days to remove Mr. Hay's composition, even with the use of sharp scrapers, when her bottom was found to be perfectly free from corrosion. The port side of her bottom has been coated with Mr. Peacock's composition, while her starboard side, which was payed over with Mr. Hay's six months since, has only been touched up, and is to remain, to test the new coating on the other side."

Kaemmerer's Improved Sowing Machine.—We have recently examined a very beautiful piece of agricultural mechanism, in the shape of a sowing machine, possessing universal applicability for all the different modes of distributing corn and other seeds, and a greater exactness in the work done than has heretofore been obtained. This machine, which is the invention of Mr. Ernst Kaemmerer of Bromberg, Prussia, may be used either as a broad-cast sowing machine, for any sort of corn, rapeseed, clover, and other seeds, or as a drill or a dibbling machine. The machine, in either case, will do its work with almost mathematical exactness, so that the farmer is enabled to determine beforehand, according to the season and the quality of his grounds, the precise quantity of seeds to be deposited over a certain extent of land, without fear of mistake on the part of his servants. As a drill, the machine is made to deposit the seeds in rows, distant from one another from 6 inches upwards to 24, and the whole breadth of the machine can always be used, thus effecting a great saving in time and labour. Mr. Kaemmerer has obtained these advantages by very simple means; only very small and easily managed alterations in the working parts being required to adapt the machine to its different actions, and the changing of the main working shaft is entirely avoided. The machine may be built so as to suit the wants of a large as well as a small farm, and its cheapness and durability will make it a most valuable acquisition even to a man who has only a few acres under the plough. All its capabilities are well attested by the first agricultural authorities in Prussia.

ENGLISH PATENTS.

Sealed from 16th October, to 13th November, 1851.

Richard Roberts, Manchester, engineer,—"Improvements in machinery or apparatus for regulating and measuring the flow of fluids, also for pumping, forcing, agitating, and evaporating fluids, and for obtaining motive power from fluids."—October 17th.

Ephraim Hallum, Stockport, Chester, cotton-spinner,—"Certain improvements in preparing and spinning cotton and other fibrous substances."—22d.

John Ramsbottom, New Mills, Derby, engraver,—"Certain improvements in machinery or apparatus for measuring and registering the flow of water and other fluids or vapours, which machinery or apparatus is also applicable to registering the speed of and distance run by vessels in motion, and for obtaining motive power and other similar purposes."—22d.

Joseph Beattie, Lawn-place, South Lambeth, Surrey, engineer,—"Improvements in the construction of railways, in locomotive engines, and other carriages to be used thereon, and in the machinery by which some of the improvements are effected."—22d.

William Boggett, St. Martin's-lane, gentleman, and George Holworthy Palmer, Westbourne-villas, Paddington, civil engineer,—"Improvements in obtaining and applying heat and light."—22d.

John Platt and Christian Schiele, both of Oldham, Lancaster, machinists,—"Certain improvements in machinery or apparatus for the preparation and manufacture of fibrous materials, which improvements, or parts thereof, are also applicable for the transmission of fluids and aeriform bodies."—22d.

Donald Henderson, Glasgow, ironmonger.—"An improved apparatus for generating gas, which apparatus may be used for heating and other similar useful purposes, and other apparatus for heating and ventilating."—23d.

John Henry Pape, Paris, France,—"Improvements in ploughs."—23d.

Jonathan Sparks, Conduit-street, Bond-street, Middlesex, surgical bandage-maker,—"Improvements in or substitutes for laced stockings, or bandages for the legs."—23d.

Henry Adcock, Northumberland-street, Strand, Middlesex, civil engineer,—"Improvements in the manufacture of pipes, chimney-pots, and hollow vessels; also bricks, tiles, copings, columns, and other articles used in building houses and other structures."—23d.

Moses Poole, Patent Bill-office, London, gentleman,—"Improvements in axle-boxes for railway carriages."—(Being a communication.)—23d.

Allen Searell, Tanybwlch, Merioneth, engineer,—"Improvements in sawing-machinery."—23d.

William Adolphus Biddell, St. John's-square, Clerkenwell, Middlesex, founder, and Thomas Green, 4 Trafalgar-square,—"Certain improvements in moulding, casting, ornamenting, and finishing articles and surfaces."—29th.

Michael Scott, John-street, Adelphi, civil engineer,—"Improvements in punching, riveting, bending, and shearing metals, and in building and constructing ships and vessels."—30th.

Frederick Grace Calvert, Manchester, Lancaster, professor of chemistry and analytical chemist,—"Improvements in manufacturing iron, and in manufacturing and purifying coke."—30th.

Thomas Greenwood, machinist, and James Warburton, worsted spinner, both of Leeds, York,—"Certain improvements in machinery for drawing and combing wool, silk, flax, hemp, and tow."—November 3d.

George Fergusson Wilson, manager of Price's Patent Candle Company, Vauxhall; David Wilson, of Wandsworth, Esq.; James Childs, of Putney, Esq.; and John Jackson, of Vauxhall, aforesaid, gentleman,—"Improvements in presses and matting, and in the

* Page 70, *ante*.

† This passage was made in a state of weather so bad, that no other steam-packet ventured to attempt it on that day.

‡ See Practical Mechanic's Journal, Vol. II., page 215.

process of, and apparatus for, treating fatty and oily matters, and in the manufacture of candles and night-lights."—3d.

Francois Marie Lanoa, Paris,—"Improvements in apparatus for holding and drawing off aerated liquors, and in machinery for filling vessels with aerated liquors."—3d.

Henry Vigurs, Camden-town, Middlesex, engineer,—"Improvements in buffers, grease-boxes, axle-boxes, and springs, and in appendages to railway engines and carriages."—4th.

Jules Francois Dorey, Havre, in the Republic of France, gentleman,—"Improvements in illuminating the dials of clocks and other instruments in which dials are employed."—4th.

Theodore Kosmann, Cranbourne-street, Middlesex,—"Improvements in brooches and other dress fastenings."—4th.

Henry Hussey Vivian, Llangollen, Glamorgan, Esq.,—"Improvements in obtaining nickel and cobalt."—4th.

Joseph Robinson, of the Ebbw Vale Iron Company, and Charles May, civil engineer, Gt. George-street, Westminster, and William Thomas Doyere, civil engineer, Euston-square station,—"Improvements in the permanent way of railways."—6th.

George Dismore, Clerkenwell-green, Middlesex, jeweller,—"Improvements in locks,"—6th.

Robert Beswick, Tunstall, Stafford, builder,—"Certain improvements in the making or manufacturing bricks and tiles, or quarries, and in constructing ovens or kilns for burning or firing bricks, tiles, and quarries, and other articles of pottery and earthenware."—6th.

Alexander Doull, Greenwich, Kent, civil engineer,—"Certain improvements in railway construction."—6th.

Michael Leopold Parnell, 32 Little Queen-street, Holborn, Middlesex, ironmonger,—"Certain improvements in locks."—6th.

William Thomas, Exeter, Devon, engineer,—"Certain improvements in the construction of apparatus and machinery for economizing fuel and in the generation of steam, and in machinery for propelling on land and water."—6th.

William Sinclair, Manchester, Lancaster, engineer,—"Certain improvements in locks."—13th.

Julian Bernard, Green-street, Grosvenor-square, Middlesex, gentleman,—"Improvements in the manufacture of leather or dressed skins, and of materials to be used in lieu thereof, and in the machinery or apparatus to be employed in such manufacture."—13th.

William Smith, Derby, William Dickinson, Derby, and Thomas Peake, Derby,—"Certain improvements in the manufacture of chenille and other piled fabrics."—13th.

George Sheppard, of Stuckton Iron Works, Fording-bridge, Hants, engineer,—"Improvements in the construction of apparatus for grinding grain and other substances."—13th.

Hugh Bowlsby Wilson, York Hotel, Blackfriars, London, Esq.,—"Improvements in the construction of rails for railways."—13th.

SCOTCH PATENTS.

Sealed from 22d October, to 22d November, 1851.

Edwin Deeley, and Richard Mountfort Deeley, Audnam Bank, Stafford, flint and bottle glass manufacturers,—"Improvements in the construction of furnaces for the manufacture of glass."—October 31st.

Alfred Vincent Newton, Office for Patents, 66, Chancery-lane, Middlesex, mechanical draughtsman,—"Certain improvements in the construction of railways."—(Communication.)—November 4th.

William Smith, Upper Grove Cottages, Holloway, Middlesex, engineer,—"Improvements in locomotive and other engines, and in carriages used on railways."—4th.

Robert Hyde Greg, Manchester, Lancaster, manufacturer and merchant, and David Bowlas, Reddish, Lancaster, manufacturer,—"Certain improvements in machinery, or apparatus for manufacturing weavers' healds or harness."—4th.

Michael Scott, John-street, Adelphi, civil engineer,—"Improvements in punching, riveting, bending, and shearing metals, and in building ships."—5th.

Benjamin Hallewell, Leeds, York, wine merchant,—"Improvements in drying malt."—5th.

Mathew Gibson, Wellington-terrace, Newcastle-upon-Tyne,—"Improvements in machinery for pulverising and preparing land."—7th.

William Longmaid, Beaumont-square, gentleman,—"Improvements in treating ores and minerals, and in obtaining various products therefrom, certain parts of which improvements are applicable to the manufacture of alkali."—7th.

Antoine Dominique Sisco, Slough,—"Improvements in the manufacture of chains, and in combining iron with other metals applicable to such, and other manufacture."—11th.

Henry Lund, of the Temple, Esq.,—"Improvements in propelling."—12th.

Frederick Joseph Bramwell, Millwall, Middlesex, engineer,—"Improvements in working the valves of steam-engines for marine and other purposes, and in paddle wheels."—12th.

William Boggett, St. Martin's-lane, gentleman, and George Holworthy Palmer, Westbourne Villas, Paddington, civil engineer,—"Improvements in obtaining and applying heat and light."—14th.

Henry Richardson, Aber Hernant Bala, North Wales, Esq.,—"Certain improvements in life-boats."—14th.

James Bagster Lyall, 45, Thurloe-square, Brompton, Middlesex, gentleman,—"An improved construction of public carriage."—14th.

James Pyke, Westbourne Grove, Bayswater, Middlesex,—"Improvements in the manufacture of leather, also in making boots and shoes."—17th.

Hugh Bowlsby Willson, York Hotel, Blackfriars, London,—"Improvements in the construction of rails for railways."—19th.

George Tate, Bawtry, York, gentleman,—"Improvements in the construction of dwelling-houses and other buildings, including carriages and floating vessels, and in the propulsion of said vessels, and in the adaptation and manufacture of materials for such uses."—21st.

IRISH PATENTS.

Sealed from 21st September, to 19th November, 1851.

Samuel Holt, Stockport, Chester, manager,—"Certain improvements in the manufacture of textile fabrics."—September 24th.

Henry Wimshurst, Broad street, Radcliff-cross, Middlesex, ship-builder,—"Improvements in steam-engines, in propelling, and in the construction of ships and vessels."—30th.

Charles Hardy, Low Moor, York, Esq.,—"Certain improvements in the manufacture of scythes."—October 6th.

Peter Robert Drummond, Perth,—"Improvements in churns."—20th.

John Oxland and Robert Oxland, Plymouth, chemists,—"Improvements in the manufacture and refining of sugar."—November 3d.

James Webster, Leicester, engineer,—"Improvements in the construction and means of applying carriage and certain other springs."—3d.

Alexis Delemer, Radcliffe, Lancaster, engineer,—"Certain improvements in the application of colouring matter to linen, cotton, silk, woollen, and other fabrics, and to linen, cotton, silk, and other wefts, and also in machinery or apparatus for those purposes."—5th.

Percival Moses Parsons, Duke-street, Adelphi, Middlesex, civil engineer,—"Improvements in parts of railways, and in cranes."—18th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 17th October, to 12th November, 1851.

Oct. 17th,	2985.	William Walker, East Bridgeford,—"Winnowing and dressing machine."
—	2986.	Holliday and Clementson, Watling-street,—"Royal shawl mantle."
—	2987.	J. H. Beaumont, Oxford-street,—"Boot upper-leather."
18th,	2988.	William L. Gilpin, Manchester-street,—"Screw capsule for bottles, jars, &c."
20th,	2989.	Chubb and Son, St. Paul's Church-yard,—"Lock."
—	2990.	Charles Hart, Wantage,—"Skim plough."
23d,	2991,	Frederick Lack, Strand,—"Anuphaton."
—	2992.	C. and J. Clark, Somerset,—"Part of an elastic part to a shoe or other covering for the feet."
24th,	2993.	James Coate and Co., Brewer-street, St. James's,—"Diagonal semi-oblique penetrating hair-brush."
—	2994.	John Kerslake, Birmingham,—"Button boot."
27th,	2995.	R. Timmings and Sons, Birmingham,—"Loose heater or Italian curling tongs."
—	2996.	Bathgate and Wilson, Liverpool,—"Cask-head and fastening."
—	2997.	George Gotch, Islington,—"Window flower-pot protector."
28th,	2998.	George Wells, Bermondsey,—"Disc valve."
29th,	2999.	W. Perks, Birmingham,—"Tap."
—	3000.	J. T. and H. Christy and Co., Gracechurch-street,—"Ventilating button."
30th,	3001.	Robert Harcourt, Birmingham,—"Blind furniture."
31st,	3002.	Deane, Dray, and Co., London-bridge,—"Enamelled gas-cooking apparatus."
—	3003.	W. Hamill, J. Kelly, and N. D. Maillard, Dublin,—"Portable flax-breaking and scutching mill."
Nov. 3d,	3004.	W. Forbes, Ellon, Aberdeen,—"Drain pavement."
4th,	3005.	Edward Phipson, Birmingham,—"Metallic bed-sacking."
—	3006.	W. Reichenbach, Borough-road,—"Reflector gas-lamp."
—	3007.	W. King, Littlebury, Saffron-Waldon,—"Bee-hive."
6th,	3008.	F. S. Bremner, Camden-town,—"Oblique pen-holder."
—	3009.	Henry Woolf, Houndsditch,—"Easy cap."
6th,	3010.	Captain H. Toynbee and J. D. Potter, Poultry,—"Revolving parallel-ruler."
—	3011.	James Wilkes, Wolverhampton,—"Circular padlock."
7th,	3012.	C. S. Vessey, Birmingham,—"Detection tap."
—	3013.	John Scartliff, Lincoln,—"Telegraphic bell-board."
8th,	3014.	Augustus Smith, Whitechapel,—"Hand-protecting stove-brush."
11th,	3015.	W. and J. Lea, Wolverhampton,—"Lock."
—	3016.	Francis Taylor, Westbourne-park villas,—"Embossing press."
12th,	3017.	J. Elce and Co., Manchester,—"Apparatus for applying grease to gearing."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 9th October, to 12th November, 1851.

Oct. 10th,	308.	William Dicks, Leicester,—"Elastic side-piece for boots."
23d,	309.	Richard Barratt, Great Russell-street, Bedford-square,—"Secured handle-brush."
—	310.	Robert John Smith, Islington,—"Steering apparatus."
28th,	311.	Gerrit Sorders, Holland,—"Double-acting safety axletree."
29th,	312.	P. A. L. De Fontainemoreau, Finsbury,—"Wire cigar light."
30th,	313.	John Roberts and W. Winter, Carlton-hill,—"Glove-fastener."
31st,	314.	William Beales, Arlington-street, Camden-town,—"Portable colour-box."
Nov. 3d,	315.	M. A. Holden, Birmingham,—"Double signal-lamp."
6th,	316.	Lambert and Co., Portman-street,—"Vertical pianoforte-brace."
6th,	317.	John Crosby, Fakenham,—"Safety sea-bathing machine."
8th,	318.	Thomas Capps, Leadenhall-street,—"Brunswick parasol."
10th,	319.	J. J. Cortins, Great Pultney-street,—"Extending boot-tree."
—	320.	J. S. Cockings, Birmingham,—"Safety lever-bolt."
11th,	321.	T. R. Grimes & Co., New Bond-street,—"Ring-head lamp cotton-holder."
—	322.	Joseph Kertchley, Ansty, Leicester,—"Chemical powder-case."
12th,	323.	J. W. Stephens, St. James's-street, Dublin,—"Fire-protector for iron safes."

TO READERS AND CORRESPONDENTS.

Received.—"The Steam Engine, Steam Navigation, Roads and Railways." By Dr. Lardner.—"Air Navigation, by means of the Rotatory Balloon." By John Luntley.—"Observations upon the Nature, Properties, and Value of the Patent Solid Sewage Manure," &c. "Reports to the Health Committee of Liverpool."

P. Horswell.—A letter was addressed to him according to the address given, and has been returned through the Dead-letter Office. We believe the patent to be a valid one.

W. M.—This valve is nothing more than the ordinary equilibrium or differential arrangement, often proposed, but on very indifferent grounds, as a safety-valve. See note to "Braidwood's Differential Safety-Valve," p. 136, for September last. If he sees reason to differ from us, we shall be glad to recur to the subject next month.

Job.—We are sorry to be compelled to postpone this matter to next month.

R. N.—The first iron-steamer built for the British Government was the *Dover*, ordered in the early part of 1839, for use as a packet on the Dover station.

R. R.—We shall find room for the machine next month.

Tau Alpha.—Will he send us a clearer sketch? We cannot make an engraving from the one he has favoured us with.

J. S., Norfolk.—Such announcements, besides encumbering our lists, would subject us to the advertisement duty in each case. We have referred his inquiry to our publisher. There are several American booksellers in London, who would supply him with any American publications. The "not one in London," is the unscrupulous reply frequently made to save the trouble of inquiry. His own bookseller should be able to procure any work noticed in our pages.

F. R. S.—The noiseless system of blowing off the steam is an immense improvement. In some instances—and it is worthy of remark, that the plan is generally followed on the Thames: the waste steam is discharged through the vessel's side, below the water line. In other cases, such as in the *Plover* and *Merlin* on the Clyde, the waste steam, instead of being merely blown away, is employed to work the air-pump during the time that the vessel is at rest, so that, not only is the steam greatly economised, but the noise and disagreeable effects of the ordinary blow-off are entirely avoided. In these particular vessels, the air-pump is quite disconnected from the engine, being worked by a detached miniature or "donkey engine," which continues constantly working, whether the vessel is in motion or not. The consequence is, that after a stoppage, the vessel again starts with a first-rate vacuum, whilst all the steam used in producing it, is condensed in the usual way.

DISCOVERY AND INVENTION.

III.

Many pages, not devoid of interest, as they might prove demonstrative of some yet unacknowledged truths, could be written on the subject of *chance* or *accident* in discovery and invention. The word has been on many tongues, and all history of these things has stereotyped it with a kind of means whereby man has arrived at the knowledge of them. Indeed this has struck us occasionally so forcibly, as to induce us to imagine that some rule or law of accident or chance was by diligence to be arrived at, and by the power of which any happy thing of the kind might be brought about at will! The singularly evident *faith* in this chance or accident, which the historians so staidly tell of, and appear to desire we should remember with great care, makes us almost tremble when, in thus mentioning the matter, without any degree of seriousness whatever, we, in reality, run counter against important modes of thinking. But as we have not created, so can we not destroy, our own belief that these magical names imply something very different from the definition commonly attached to them. Why should any observation be made precisely at that moment, and at that moment only, in a long life, or in a long interval of time, when some other observation or law becomes involuntarily associated with it, and gives rise to thought and reflection? The answer to this question would be the solution of the great problem, which is ordinarily passed over without further thought, than, on the one hand, fortuity, and, on the other, a special providence. The observation of the falling apple by Newton, and that of the curious vein-valves by Harvey, are instances. It seems to us the result of indolence alone which has made philosophy rest in such ultimate causes; and man has been heedless of the power he is endowed with, at such long distant moments, or, in his awakened effort, to follow the course of the effect he has been careless of inquiring into, viz., the secondary physical cause. Bacon, whose views extended alike over the vast and the minute in nature, endowed his philosophy with the means of tracing out such things; and as one of its glorious results, he expresses a hope for further, better, and more frequent results from man's reason, industry, method, and application, than from chance and mere animal instinct and the like; which, as he justly goes on to say, have hitherto been the sources of invention.* True thinkers have universally declared that all useful discoveries have been made, not by the brilliancy of genius, but by the diligent direction of the mind to one object, as in all professions, even in trades, success can be expected only from undivided attention. Both chance and accident must, by the diligent searcher into being, and forms (including laws) of being, be considered discarded. Mr. Turner, in his little popular work, "Counsel to Inventors," observes, that the so-called accidental discoveries in art and science, when accurately looked into, show, in almost every case, a casual circumstance, only so far operating as it puts in motion a train of thought in an already well-stored mind, and that train of thought, too, has, in most cases, been elaborated with painful diligence from its rude original into full development. All that it is requisite the searcher should be careful to implant in himself, and to be ever present with him, is—a state of seeking. To the occurrence of this state simultaneously with the occurrence of the fact newly observed, or observed while in this state, are really owing the many discoveries and inventions which history tells us have resulted from fortuity. It is related that Von Kleist, a German prelate, in 1745, received a sudden shock in his arms and breast, while handling a vessel containing water, in communication with an electrical machine; but it was reserved to Cunæus, in his laboratory at Leyden, to furnish for ever to science that peculiar kind of jar, baptised with the name of his place of residence, by not simply being amused with a similar "accident," but by proving it to be the result of bringing the inside and the outside of the vessel into connection, and the shock resulting from the violence of nature's effort to regain the equilibrium of electric force. Let Dr. Whewell speak: "A new mode of producing electricity has elicited much notice lately. In October, 1840, one of the workmen in attendance upon a boiler belonging to the Newcastle and Durham Railway, reported that the boiler was full of fire; the fact being, that when he placed his hand near it, an electrical spark was given out. This drew the attention of Mr. Armstrong and Mr. Pattinson, who made the circumstance publicly known. . . . Dr. Faraday took up the investigation, [and showed] that the electricity is produced by the friction of the particles of the water carried along by the steam."† Here we see how gradually the wild wonder at the chance, or accident, became resolved by the distinguished master of science into its true elements. Dr. Whewell, in another place,‡ says, and says truly, that no scientific discovery can with any justice be considered due to accident. But he does not go on to show to what it is due, or explain what that state of things called chance, or accident, consists in. We would sum up the little we have said on the subject, by suggesting that no discovery or invention ever has been or can be expected, under any concatenation of circumstances, however happy, when the mind is not in a state of seeking discovery or invention; and that the best hope of making either, may be very properly entertained under circumstances, however apparently adverse, when attention remains aroused to the probability, or even possibility, of discovering or inventing.

The subject to which we will now turn a thought or two, is the relation between the poet and the discoverer—intending to say a few supplementary words, by-and-by, as to the relation existing between the poet and the inventor. The more intensely we abstract our attention upon the nature of discovery, the more deeply we shall be impressed with the alliance that exists between what Baron Humboldt has termed the two great spheres of the intellect and the feelings—investigating thought and creative imagination.§ This it is which enables us to see how intimately connected the great discoverer must be with that element in which the poet "lives, and moves, and has his being." The poet roams at will the boundless universe; his eye, rolling in a fine frenzy, glances from earth to heaven, and from heaven to earth, making the finite infinite, and that which appears perishable, to endure for ever. Himself his own rule and law, he lives in an atmosphere of unchanging freedom, now busied with the minute, now soaring among the vast. Who shall invent the instruments to bring the object of his thought into the common light of day? He is, after all, but a discoverer of another mould. His imagination, in its highest moods, but "bodies forth the forms of things unknown," and gives "local habitation and a name" to "airy nothing." This, too, is the precise office of the more ordinary discoverer. Some happy thought, of which he cannot trace the origin—some peculiar cast of intellect, rising above all rules and forms of precedent thought—thrusts him at once upon the apex of the pyramid of humanity, and he throws a new light upon all things. In some cases, before the appropriate conception is matured, and he can see clearly what the new truth *is*, he has often benefited mankind by demonstrating what it *is not*. He has, indeed, a greater difficulty in performing his task than has the poet, for the *proof* of his speculations is the *sine quâ non* upon which the foundation of his honour, as a discoverer, has to rest. Hence, and hence only, arises all fame of this description. "I drew the conclusion," says Lavoisier, "that the combinations and decompositions of electricity were referrible to the law of electric attractions and repulsions, and advanced the hypothesis that chemical and electrical attractions were produced by the same cause, acting in one case on particles, in the other on masses, and that the same property, under different modifications, was the cause of all the phenomena exhibited by different voltaic combinations." Dr. Whewell‖ remarks, that although this is the enuncia-

* Nov. Org. Aph. 108.

† Hist. of Ind. Sci., vol. 3, p. 45, note (B). Ed. 1847. ‡ *Ibid.* vol. 2, p. 189. § Cosmos, vol. 2, p. 127. ‖ Hist. of Ind. Sci., vol. 3, p. 178.

tion in tolerably precise terms of the great discovery of this epoch—electrical attraction and repulsion—it was, at the period in which Lavoisier lived, conjectured rather than proved; and neither Sir Humphrey Davy nor his followers, for a considerable period, apprehended it with that distinctness which makes a discovery complete. Dr. Faraday afterwards furnished by experiment what was required, by showing the identity of electrical and chemical action; and with that candour which is the constant companion of the great mind, acknowledged it to be but a confirmation of the general views put forth by Davy, and might be expressed in his own terms, that "chemical and electrical attractions are produced by the same cause." The whole wide region of conjecture and hypothesis belongs to the poet, while but a portion of it, here or there, belongs to the discoverer. It is, however, as has been observed,* to such scarcely embodied conceptions of some great mind or minds, expressed in the modest language of even doubt, that the next age commonly owes its most brilliant discoveries, experimented or proved by men probably much inferior in mental power to him who dimly saw the form of truth in the distance, and pointed to the glorious vision. Literature informs us that Zenophanes observed the fossil remains found imbedded in rocks, and that he imagined from thence that the earth must at some previous time have undergone notable revolutions, in which the previously existing things had perished. The pages of Plato show, that in the midst of his sublime thoughts, he had attained an intuitive vision (not yet moulded into knowledge) of what the natural philosopher of the present age tells us with certainty, that the action of magnetism and electricity, as shown in the loadstone and amber, when excited by friction, is not owing to any peculiar attraction in these substances, but to the movements communicated through ambiguous particles under peculiar circumstances. His theory, also, of the nourishment of the body by the affinity of certain particles for each other, and their consequent assimilation, is also, as a modern writer† notices, in a great measure that of common chemistry. It was Pythagoras who probably first ventured the vague thought, which ultimately resolved itself into the atomic theory, or the theory of definite proportions of Dalton. But it would be almost endless to detail the many instances of this kind, in which the acknowledged discoveries of the philosopher bear relation to the exhibition of "fine frenzy" which so prominently characterises the poet. But the subject is interesting, and we cannot help noticing a few others. We confess it to be a foible in us to catch at anything which may add greatness to the greatness of Francis Bacon, which, indeed, every reperusal of his principal work does. It was the poetry in him that made him approximate so closely to the discovery of time being required to the propagation of light. It was the poetic faculty with which his soul was bound up that enabled him to approach so nearly to the discovery of the decomposition of light, and which, although subsequently maintained by De la Chambre and Isaac Vossius, was left to be proved by Newton, and, owning this, enabled him to leave, in his great work, in several passages, many hints of that grander law which has rendered that name of Newton immortal.‡ Many others have possessed this intuition of scientific induction. The history of the undulatory theory—which will probably maintain its ground against all new-comers for some time to come—would commence with the conception of it by the active mind of Huyghens; and some of Swedenborg's greatest admirers and disciples are fond of ascribing to his penetrative genius, many discoveries subsequently made known to the world by the professed astronomer, chemist, or anatomist. Endowed with wisdom, or the ability to become conscious of the true, these poets of the scientific world are, as this their name implies, endowed also with that power which is universally known by the name of genius; and surely it is to the possession of this power also, that the discoverer owes his own position. The march of each may be said to be over the same ground; and although one may be quicker than the other, both are sure, and terminate at the same goal, as they started from the same spot. Both are, above all, benefactors of our race; for while the one excites into being the simple mental power, the other places it where it may healthily and honourably exercise itself. That we may see how discovery may, as it is often said, be incomplete as well as complete, bearing in mind the few words above, we shall be prepared to think that even the bare statement of the possibility of a thing is an incomplete discovery, and entitles the propounder to no mean portion of the honour awarded, or which ought to be awarded, to discoverers in general. Discoverers and travellers are the true princes of the world; and they stand, whether against or with the general will, precisely in the same relation to others of the human race, as man himself stands in relation to the brute. How wide a field is open for advantageous speculation of this kind, when the suggestion of even a *desideratum* may not inaptly be termed an imperfect discovery! How much must there be wanting in everything, if we were to look carefully into our present acquisitions! How many "possibilities" might, by a little reflection, be suggested by a little of more than ordinary scrutiny! How many millions of facts are as yet without an appreciable law to bind them together, and by which, so bound, they may be handed down to posterity in that museum of mind which the present is ever filling up and completing for the instruction of the future! Were we called upon to speak dictatorially, we should say that discovery was a part of morality, and that to discover should form some portion of the teaching of schools, whether the little or the great; for what, we would urge, is that greater exercise of morality, than the making crooked paths straight, the erection of guide-posts to the weary traveller, and beacons to direct him safely to the comforts of home?

We have said so much on the connection between the poet and the discoverer, that a few words must suffice on the relation between the inventive and the poetical faculty. Indeed, on this point, many of the observations immediately preceding may, with justice, be equally applied to the inventor as to the discoverer. But invention has this peculiarity, that it is intimately connected with immediate practice, which discovery, obviously, cannot be. As we invent, the power of inventing increases; but the power of discovery is of uniform intensity, if it do not diminish. The more we *know*, the more bewildered we are with the greater circle of wonders around us; but the mind of the inventor is like a shuttlecock, which, receiving momentarily a fresh impulse, may make a more distant flight at every blow of the battledoor. "It is only the practised hand," it has been remarked,§ "that becomes familiar with the means and capabilities of art; only in the practised mind that the trains of ideas follow in their order, unconsciously, for at the moment of invention the means must be forgotten. The theory of a subject must be studied, the practice must be known, but neither can be acquired at the time of composition; he who would blend them successfully, must have both at his fingers' ends." It is this principle that discovers the poet in the inventor, who, in the instant of invention, brings up to a higher station all appliances before known, making their new combinations produce a new thing in the order of creation. In the inventor there is, perhaps, more of the poetical element than in the discoverer, if we look on the outside only of their respective industries; but when we pry into the unseen foundations of each, we readily see that genius—that originality—that pushing-forwardness, in these crafts, is equally divided between them, and that, withal, each has more than with common men that peculiar receptiveness—passiveness, call it what you will—by which he suffers all before he attempts to act: an eminent characteristic of the great poet. It is this very greatness in invention that is its bane. It subordinates to that one power all other powers of acquisition, and determines the direction, as well as limits the extent, of all mere reading, exclusively in relation to it; and the higher we go in invention, from a simple piece of mechanism to a grand construction in mathematics, we shall find this

* Small Books on Great Subjects. No. 6, p. 88. † *Ibid.* p. 64.
‡ See Nov. Arg., B. 2, Aph. 46, 22, 36, 45, 48.

§ Turner's Counsel to Inventors.

to be the case. Miscellaneous knowledge—general information, are absolutely necessary to discovery and invention. Dugald Stewart said it was one of the numerous disadvantages attending an inventive mind, not properly furnished with acquired information, to be continually liable to waste its power on subjects previously exhausted; and this, indeed, is so obvious, that the highest power of this order dare not, in the present day, when invention walks the highway of the world, disregard it. More and more must the would-be discoverer and inventor be found among the knowing and the learned. This is on the path to every other excellence; and there is nothing to be wondered at in it, when, with reference to the grand idea of humanity, it may be written down as a truth, significant to all, that discoverers and inventors are the only men.

This leads us to urge, that no discovery or invention that has ever been made is useless. There is a constitution of utility attached to both, which is a necessary quality of its essence. It is the characteristic of the greater mind to perceive this *in extenso*, as it were, instinctively; and this is by no means extraordinary when we know, that every tittle discovered serves to establish a general law. There is this, however, distinguishable between discovery and invention—the *cui bono* is not necessarily synchronous with discovery, but it is always so with invention. The inventor may, with becoming dignity and self complacence, point to the present hour and exclaim, "There, see before your eyes the beneficial result of my noon and midnight toil;" and the discoverer may, with no less pride, point to the unheeded result of his own labours, and say to his friend, "There lies the instrument with which the not far distant time shall supersede all that you yet have done."

Erratum.—Page 193, *ante*, 2d col., line 11, for "Georgiana," read "George."

FRANCE IN THE GREAT EXHIBITION.

To France we owe our earliest lessons on the formation and management of grand industrial exhibitions, and to her—as our own recent magnificent display has exemplified—are we now indebted for no inconsiderable portion of those splendours which have combined to make the collection—what all the world now knows it was. Next to the United Kingdom, the combined avenues and galleries of France and Algiers, were by far the most important and attractive in the Exhibition.

We have often endeavoured to show how much France has gained by her own expositions, and we may now safely point to her display in Hyde Park, as an unqualified confirmation of all, and more than all, that we have advanced. In no single class has France failed in her desire to be eminently well represented. Raw materials, machinery, manufactures, and the fine arts, have each stood out in bold relief, and, down to their thirty subdivisions, have filled important ranks in the collection of the world's productions. The exhibitors were 1,750 in number, occupying —as most of our readers know—extensive areas both on the north and south sides of the eastern nave, together with a large extent of gallery space.

In raw materials, the silk, both raw and thrown, hemp and wool, vegetable alkaloids, metals, and specimens of prepared food, call for more especial notice; whilst in machinery, the turbines, cotton-spinning and carding machinery, machines for making endless sheets of paper, and philosophical and optical instruments, are pre-eminent. In manufactures, the Lyons silks, and, to a greater or less degree, the cotton, linen, and woollen fabrics, lay claim to honourable mention, more especially for their evidence of artistic feeling in pattern designing; nor are the tapestries of the Gobelins and Beauvais, or the porcelain of Sevres, to be forgotten. Purely artistic productions, or what modern parlance has dubbed art-manufactures, form so large a proportion of the subjects to which Parisian industry is devoted, as to render it almost needless to mention the great importance of these and other collateral branches of the fine arts. We may, however, particularise lithographic printing, stereotyping by new processes, daguerreotypes and photographs, both on paper and glass, and sculptures.

In the galvanic battery of M. A. E. Lemolt, manufactured by M. Loyseau, an optician of Paris, thirty pairs of plates are said to be sufficient for the necessities of five great telegraphic lines in France—the extent of line thus supplied, being equal to about 1,500 miles. The chief feature of the arrangement, which is a modification of Bunsen's, consists in the production of a constant deposition of copper upon the upper surface of the charcoal or coke cylinder, so that the metallic contact of the metal and cylinder is preserved.

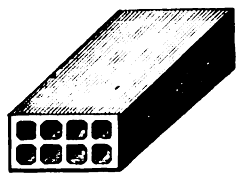
M. Picault, whose oyster-opener has been some time introduced in this country, is also the inventor of a shear-carving knife, and saw-edged carving-knife. The shear-carving knife is intended principally for cutting up fowls, and is a species of compound of scissors and carving-knife—the theory being, that whatever cannot be severed by the knife, may safely be left to the action of the scissors for cutting without spoiling the dish. The saw-edged carver, as its name indicates, provides for cutting through the bone with facility, without interfering with the ordinary cutting functions of the mere knife.

As an improved covering for roofs, M. Amuller of Paris exhibits an improved tile on a model roof. This tile is flat, the edge by which it is encircled being open at the bottom to admit of a free egress for the water. An inner edge, shaped like a horseshoe, occupies the upper part of the tile, and the two edges correspond with the wedgings which the tile has on its reverse side; and in this way, by covering the upper part of its surface with two others, set side by side, the two edges are wedged in, and quite covered over by the two upper tiles, hiding all the lower one except the arrow-head, allowing the water to run down to the under tile. The correct and deep wedgings of the edges, with the essential feature of the entire covering of the joints, render it impossible for snow or rain to penetrate roofs so formed.

In motive power, France of course appears as a turbine-maker. The example she sends is by Messrs. Fromont & Son of Chartres, and is termed by them "an improved double turbine, on Fontaine's principle," having independent compartments in the actuating wheels, working either conjoined or separately, so as to suit the machine to the exact quantity of water at hand. The ordinary pendulum-governor is employed as the speed-regulator, and is arranged to open or close the additional compartments as the rate of motion may require. From 70 to 79 per cent. is stated to be the useful effect of machines of this construction; that at the flour-mill of Vadenhay, near Chalons-sur-Marne, with 6 feet 3 inches fall, giving a return of from 78 to 79 per cent. The workmanship throughout Messrs. Fromont's turbine is very good, although there are, of course, many details which strike the English machinist as being crude and out of place.

There has latterly been a strong movement in this country in favour of the use of hollow bricks, of which, together with a machine for manufacturing them, Messrs. Borie of Paris are exhibitors. Four kinds are made in the machine: ordinary cellular bricks, double bricks or stretchers, headers, and quadruple bricks of wall breadth. The annexed figure 1 represents the ordinary sized brick, having within it four longitudinal cells, each separated from its neighbour by a mere thin shell of material. Such bricks differ very materially from anything of the kind made here, in being cellular. They may thus be made of any size without any difficulty in burning, and weigh only one-half in comparison with solid bricks of the same cubical dimensions. They are as strong as solid bricks, and, by reason of the thinness of their substance, may always be uniformly burnt. There can be little doubt as to the approaching universal use of bricks of this kind, for as non-conductors of heat, cold, sound, and damp, they present undeniable features of superiority over the solid brick.

Fig. 1.



Some excellent files were shown by Messrs. Alcan and Locatelli of Paris. They are manufactured by a new process, recently patented both in this country and abroad—the teeth being hardened at the very time that they are cut. The French patent is being worked by an operative association in Paris.

Amongst a selection of philosophical apparatus, M. Deleuil of Paris exhibited a mint-balance, constructed on Seguier's principle, and arranged to weigh coins and separate them into three classes—the correct, the overweight, and the deficient ones. The delicacy of this machine may be described by mentioning, that it is capable of detecting variations from the true weight within 2-13ths of a grain, according to the size of the coin, either above or below the standard. The coins to be weighed and tested are placed in a hopper or receiver, as in Mr. Oldham's Bank of England machine—this hopper having one of its sides formed by the section of a wheel, fitted with projecting pieces of steel of given lengths. The longest of these pieces is made to prevent the accumulation of coin; the shorter ones have, between their extremities and the bottom of the hopper, the thickness of a single coin, and support the upper coins to allow the lower one to slide on to the inclined plane beneath, so that, one by one, they all arrive at the escapement, which permits only one piece to fall at once. By this means they arrive at the balance for separation

into the three classes. The beam has a needle, carrying a pallet on its extremity, and above the upright of the balance are placed two small plates, each fitted with a fine steel wire, traversing the support of the beam. On one end of these needles are handles communicating with cross-bars stretched by springs, whilst the other ends of the handles rest on projections. When the balance is level or inert, the cross-bars are on a level with the inclined planes which carry the coins downwards. If the passing coin is of the right weight, the needle over the balance passes between the two small plates, and the coin falls into the centre basin of a line of three, placed to catch the falling stream. If it is above the standard weight, the needle inclines to the right, raising the plate and the attached wires with it; and as the handles do not then meet the wire, the cross-bar to the right stops the passage, and directs the coin to fall into the end basin to the right. When a deficient coin comes down, the left plate is raised, the wire which stops the handle comes into action, and the cross-bar to the left stops the passage, sending the coin into the opposite end basin on the left. The machine weighs coins to the $\frac{1}{65}$th part of a grain, weighing at the rate of 50 per minute in each scale, so that, with two balances, 100 coins are tested per minute. A balance for ordinary philosophical purposes, so delicate that, when loaded with 9 lbs., it detects the $\frac{1}{65}$th part of a grain, or the $\frac{48}{1.000.000}$th part of the weight which it will bear, was also exhibited in the same collection. It is on the same principle as the great balance purchased by the French Government for the "Conservatoire des Arts and Metiers," which, when loaded to 22 lbs., exhibits the true weight to the degree of accuracy which we have already noted.

M. C. T. Fumet's "Sabotière," for making ices, consists of a pail, expanding upwards to the top, which is covered, and having within it the inner vessel, or sabotière, slightly conical in shape, and resting on the pail by a projecting rim. The freezing mixture, composed of pulverized sulphate of soda and chloro-hydric acid, is placed in the pail, and the cream to be iced in the inner vessel. The whole is then taken by the handle of the sabotière, and has an alternate rotatory motion given to it for about a quarter of an hour, the freezing mixture being renewed every fifteen or twenty minutes.

As means of preventing forgery, Messrs. Meillet & Pichot have introduced a novel kind of paper, as well as a combination of inks for laying on different impressions, to prevent the possibility of counterfeits. It is matter of notoriety, that the most elaborate and artistically finished examples of engraving have been so admirably copied, that the most practised eye could not detect the fact of the copying, or distinguish the imitation from the original. To render talent of this nature of no avail in forgery, Messrs. Meillet & Pichot have hit upon the idea of so combining different printing inks, that their superposition shall preclude all chance of a close imitation of the impressions. In the postage stamp, for example, the figure is printed in an ink which, when brought into contact with nitric acid, diluted with two-thirds its volume of water, becomes of a greenish-blue colour. The watered filigree ornament round the figure is printed with another kind of ink, which, touched with the dilute acid, at once becomes a rose tint.

Amongst other mechanical contrivances, we find M. Eugene Bourdon, the Parisian engineer, with several instruments for measuring and registering the pressure of steam, the height of the water in steam boilers, and gas regulators and barometers. His water-level indicators are particularly neat. A small tubular pillar is placed on the boiler, directly over the stone float, the wire from which passes up the pillar to an index, pointing to the measure of the water on a segmental scale at the head of the pillar. The apex is surmounted by a steam-whistle, to give notice of a dangerous subsidence in the water-level, whilst a branch from the lower part of the pillar admits of the placing of a weighted lever safety-valve.

But the most interesting and important of M. Bourdon's contributions, is his new metallic manometer. Figs. 2 and 3 represent front and back views of this ingenious contrivance. Fig. 2 being a front elevation of the manometer complete, with the index at zero; fig. 3 is a corresponding back elevation, with the external case removed to show the mechanism.

It has probably been observed by many of our readers, that internal pressure in coiled tubes has a tendency, more or less, according to circumstances, to cause an unwinding of the coil, or, in other words, to bring the tube to a straight line. Such an effect, for example, is frequently witnessed in the hose of fire-engines. It is this peculiar action which M. Bourdon has so ingeniously turned to account for measuring and indicating fluid pressures. In the course of manufacturing a coiled copper-worm for a still, one side becoming flattened by accident, internal pressure by a force-pump was applied to restore the cylindrical form, and to the astonishment of M. Bourdon, as the pressure increased, the coiled tube unwound itself, until it became nearly straight. This induced further experiments, which resulted in the production of the various instruments recently exhibited.

Fig. 2.

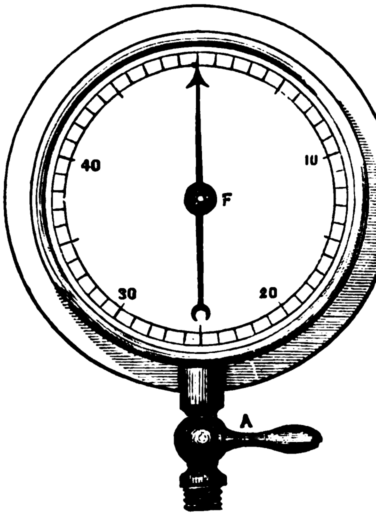
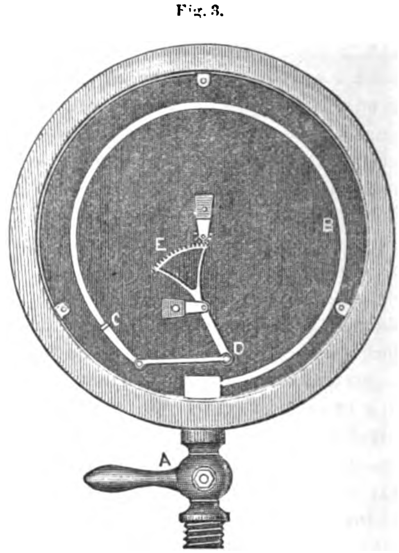


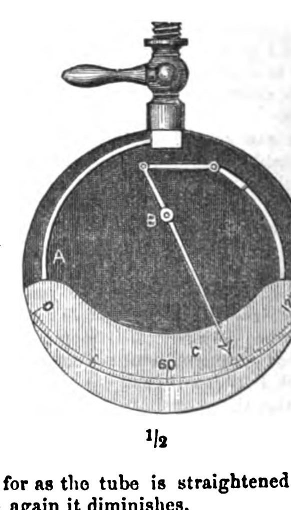
Fig. 3.



1-4th.

The transverse section of the coil is that of a flattened tube, which, when acted upon internally by the pressure of steam or any other fluid, has a tendency to uncoil itself as the density increases, and to return to its original form on the pressure being removed. If it is exposed to external pressure, or a partial vacuum created within it, the tendency of the tube is to coil itself up into a smaller diameter. In the former case, as the tube uncoils itself, its sides become more convex, and its capacity greater; and, in the latter instance, the capacity diminishes as the sides collapse and approach each other. It is on this relation, between the capacity of the tube, or the amount of convexity of the sides, and the diameter of the coil, that the action of the instrument depends. If a flat band of metal is bent round a circle, its transverse form remains unaltered, but if a semi-cylindrical or gutter-shaped band is bent into a circular coil, its convexity is diminished; and if the circle formed by it is of small diameter, the band becomes almost flat in the transverse direction. It being then a law of general application, that a surface which is curved in two directions, cannot have its curvature increased in one direction, without its curvature being diminished in the other direction, and *vice versa*, the action of the instruments in measuring pressure or temperature is easily understood.

Fig. 4.



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The variation in the thickness or capacity of a curved flattened tube, may be shown by filling the tube with a liquid, and attaching to the centre of its external periphery a small glass tube; when every change of curvature produces a corresponding motion in the liquid in the tube; for as the tube is straightened its capacity increases, and as it curls up again it diminishes.

The change in the thickness or capacity of the tube being proportional to the variation of its radius of curvature, it was found, by experiment, that the motion of the extremities of the tube was in proportion to the pressure applied, so that the indications were equal for equal in-

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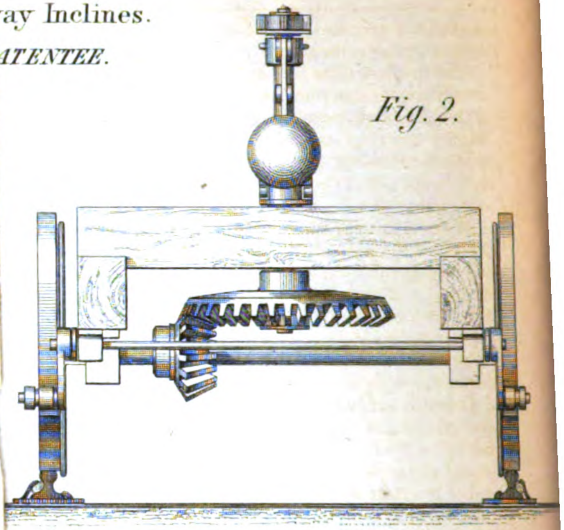
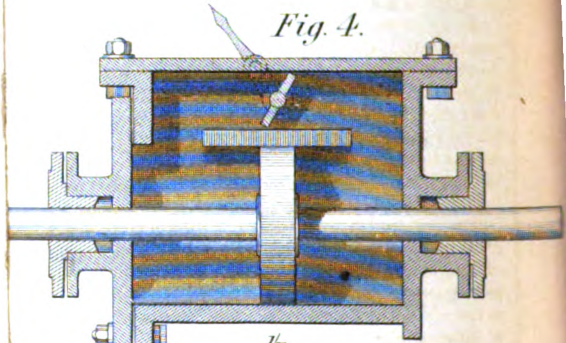
Fig. 2.



10 Feet

Fig. 4.



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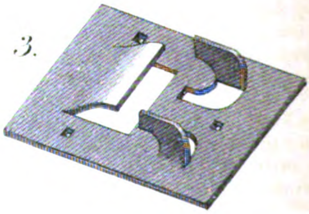
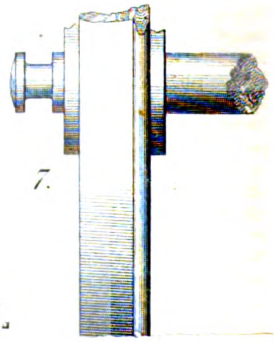
3.





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CHAIRS.

crements of pressure; this fact greatly facilitated the construction of the indicating instruments.

The simplest form is that of the steam-pressure guage, in which rather more than one convolution of flattened tube is employed; one end being attached to a stop-cock in connection with the boiler, and the other extremity carrying an index pointer, which traverses a scale graduated to given pressures per square inch; on the steam being admitted, the tube uncoils, and the pointer indicates the amount of pressure to which it is subjected.

When a greater range of motion is required, the lever, instead of being placed on the axis of the index, carries a toothed segment, which, working into a pinion on the spindle of the index, increases the extent of indication. This arrangement is adapted for barometers, in the construction of which the air is exhausted from the flattened tube, which is then hermetically sealed. The pressure of the atmosphere acts on the exterior, and is balanced by the elasticity of the tube, which varies in curvature with every variation of the pressure of the atmosphere.

It is this arrangement which we have represented in figs. 2 and 3, as applied for measuring steam-pressures. The guage is connected with the boiler by the pipe and stop-cock, A, the upper end of this pipe being passed through the rim of the indicating dial, and opening into the fixed end of the flattened tube, B, the sides of which are slightly convex. The tube, in this instance, is not quite a full coil, but extends round inside the case to C, where it is hermetically sealed up. To this end is fixed a short eye-piece, jointed by a short link to the end, D, of a toothed segmental lever, E. This lever works on a centre inside the case, and actuates a pinion on the axis, F, of the index-hand. This index works outside a dial, graduated, in the present instance, to 50 lbs. per square inch, the whole being covered over with glass.

In fig. 4 we have delineated another modification, in the form of a pendant dial, the elastic tube being linked directly to the index-hand. In this case the steam enters from above, and acts upon the tube, A, as in the former example, the index, B, being actuated by a simple link from the free end of the tube. The centre of motion of the index is placed high up in the case, the needle pointing to a graduated arc, C, on the lower side. The whole is covered in with glass, so that all the mechanism, except the portion of tube covered by the graduated arc, is plainly visible.

The original instrument from which the drawing, fig. 4, was made, is fitted on the boiler of the small Clyde steamer "Witch," the property of Hugh Mair, Esq. It is set to indicate up to 120 lbs.; and although so extremely small, being only 3 inches across the dial, it is found to give very accurate results. The simplicity of its indicating connections, of course, renders it much more delicate than the form shown in our earlier figures. It is, however, obvious, that the attachment of the index directly upon the free end of the tube, can alone insure the utmost delicacy of measurement.

Many ingenious modifications of the principle, and adaptations of it to various purposes, are shown by M. Bourdon. The construction of thermometers by a spiral flattened tube, is extremely novel and good; that also of a pyrometer, for measuring high temperatures, is equally clever. The steam-engine indicator, constructed on this system, becomes a very simple instrument, avoiding the error which is to be allowed for the friction of the piston of the ordinary instrument.

The instruments are very generally adopted in France, where the government-inspectors of steam-engines use pressure-guages on this principle, in verifying the accuracy of all the other instruments they find attached to the engines under their inspection. At the French Exposition of 1849, M. Bourdon received a gold medal, and on the present occasion he has been rewarded by a Council medal.

The mechanical or antiphonel piano of M. Debain, is intended as a substitute for organs and harmonicons, as being superior to, and more economical than, the common barrel action. The flat surface of the upper part of the antiphonel is covered with a plate of metal, pierced across with a series of apertures, admitting corresponding metal points, projecting 1-8th inch above the plate. These points are on the ends of corresponding levers communicating with the action of the instrument, and they are pressed down during the operation by a small piece of hardwood studded with pins, and held down by an upper bar regulated by springs. This is passed over the key-frame by turning a handle, and as the pins on the piece of wood strike the antiphonel keys, the notes are given—hard or soft, as is required. Eight inches long of the studded bar gives as much music as is ordinarily contained on a sheet of music. The antiphonel is capable of being placed on a piano as a cover, the instrument being played in the usual way when the cover is raised.

The sewing machine of M. Maguin of Villefranche, and termed by him a "Cousobrodeur," answers for various kinds of sewing, embroidery, and cord-making. It is in the form of a common work-table, surmounted by a small box for holding the principal mechanical details, and fitted with a pedal. The operator, sitting before the instrument, works the pedal action, and guides the material to be sewn, in a horizontal direction, each stroke of the pedal causing a crotchet-hook to pass through the fabric, forming a series of stitches. An adjusting screw enables the attendant to regulate the fineness of the work, and to sew tighter or slacker as need requires, at a rate of 250 stitches per minute. In embroidering, the needle is actuated by a second pedal suited for the left foot.

It is a remarkable fact—paralleled only perhaps by the manufacture in England of woven fabrics for the use of the very countries which grow the raw material from which they are made, at a distance of from three to four thousand miles from our spinning mules and looms—that raw copper ores are actually shipped to Swansea to be smelted, in preference to reducing the metal at the brink of the mines. Various distant European shores, and even Cuba, Mexico, Columbia, New Zealand, Chili, Australia, and Peru, now furnish our Welsh smelting furnaces with their raw material in abundant supplies. Now, as the "crystallized grey copper ores" in the Exhibition have shown, we have added another supplying country to our list—the company working the Monzala mines in Algiers being about to transmit to us a first shipment of 2,000 tons, a transaction which will doubtless be speedily followed by others of a similar nature.

HILL'S SELF-ACTING BRAKE FOR RAILWAY INCLINES. HILL'S WROUGHT-IRON CHAIRS.

(Illustrated by Plate 87.)

Our compound plate 87, exhibits combined and detailed drawings of both these inventions, invented and patented by Mr. Laurence Hill, Jun., C. E., of Glasgow. In devising his "Self-acting Brake," Mr. Hill has had in view the prevention of those fearful accidents, of which we have had more than one example at the Glasgow terminus of the Edinburgh and Glasgow Railway, where the trains have occasionally descended the steep incline in the tunnel, at a perfectly unmanageable velocity, committing great havoc at the termination of their run. In the plans now brought forward, means are provided for arresting the progress of the trains, whenever their rate of motion exceeds what has been decided upon as a safe velocity. The two first figures on our plate, exhibit the mode in which the ordinary pendulum-governor is arranged to effect this end. Fig. 1 is a complete longitudinal or side elevation of an ordinary brake van or truck, as fitted according to Mr. Hill's plans; and fig. 2 is a corresponding end elevation of the same. On one of the axles of the truck is keyed a small bevel pinion, gearing into a bevel wheel set just beneath the framing, and keyed on the extremity of the spindle of an ordinary governor, standing up above the truck bottom, in which it has its bottom bearing, whilst its upper end is supported by a curved overhead bracket. To the sliding ring of this governor is fitted the forked end of a long lever, having its end fulcrum on the top of the end frame of the truck. Somewhere near midway between this fulcrum and the governor, a link is jointed to the lever, and hanging downwards—its lower end is jointed to a short lever set beneath the frame, on a horizontal transverse shaft. The extremities of this shaft carry similar levers, arranged so that their free ends may press against the outsides of a pair of friction straps lined with wood blocks, the opposite end of each strap being linked to the truck frame, in such manner as to half encircle the rims of the wheels. The other pair of wheels is similarly fitted with friction straps, actuated by levers and side rods from the first-mentioned motion. As the velocity of the train, carrying with it one of these trucks, increases, the rapid revolution of the governor causes a greater or less divergence of the governor balls; and when this divergence exceeds that due to a safe rate of travel, the sliding governor ring elevates the lever, and thus forces the first friction blocks on the four straps, into contact with the wheels. The friction thus produced by a single block in each case, at once drags the whole of the other blocks into frictional contact with the wheel rims, thus quickly diminishing the velocity of the train's descent. In this way—as all that is required in the first instance is to bring a single block to bear—a pair of very light governor balls answers to work a very powerful brake, inasmuch as the very revolution of the wheels themselves brings the entire brakes to bear, when the first blocks have shown the example. The speed of the train being checked in this way, the balls partially resume their original position, permitting a relaxation of the brake pressure, and the train then proceeds at its ordinary rate. The action of this simple apparatus is very sensitive, and it works without jolting, or any irregularity, on the steepest inclines.

The third and fourth figures on the plate, illustrate the means by

which the incompressibility of fluids is taken advantage of, in attaining a retarding power for the same purpose. Fig. 3 is a side elevation of a truck fitted in accordance with this idea; and fig. 4 is a longitudinal section of the fluid-retarding cylinder. To one side of the truck-frame is bolted a short cylinder, with a cover and stuffing-box at each end. This cylinder is fitted with an ordinary piston, one end of the rod of which has a slotted cross-head, in which works the slide block of the pin of an outside crank on one of the truck axles. As the truck runs down the incline, the revolution of the cranked axle drives the piston rapidly back and forward in the cylinder. The section, fig. 4, exhibits the effect of this action when the cylinder is filled with water or oil. The two ends of the cylinder are in connection by means of wide ports on the upper side—midway between which is set a close-fitting valve, like a throttle-valve. When this valve is set full open, free passage is left for the contained fluid from one end of the cylinder to the other, and little or no resistance is offered to the reciprocatory traverse of the piston. If, however, this regulating-valve is partially closed, the fluid can then only be driven from end to end at a comparatively slow rate, the piston being then allowed to make only a certain number of strokes in a given time, so that the rate of revolution of the brake-wheels is retarded in the same ratio; and the speed of the train is therefore reduced to a certain determined number of miles per hour. The fore and hind wheels are coupled in the usual way, or a crank may also be fitted to the axle of the second pair. The regulating-valve spindle has an index handle, pointing to a graduated arc above—referring to the number of miles per hour, at which a given opening will permit the truck to travel—so that, by setting the index to any given number, the train will always be retarded when coming up to that rate. The drag-hook of the brake is attached to the valve-spindle in such manner, that when the truck is being hauled up from the bottom of the incline, the valve is held full open, so as to offer no resistance to the working of the piston; but whenever the strain is taken off the hook, the spring at once closes the valve to the requisite degree, and the brake is again ready for use in the descent. It is obvious, that by the adoption of either of these plans, directors of railways may save themselves from the fatal consequences so frequently arising from neglect or accident in descending steep gradients.

The seven smaller figures on the lower half of our plate, illustrate very fully Mr. Hill's ingeniously-contrived wrought-iron railway chairs. These chairs can be made to suit any kind of rail, but the principle is best suited for the flat-bottomed or bridge rail. They are made from a flat bar of wrought-iron, rolled to a width equal to the length of the chair to be made, the thickness of the plate being from $\frac{1}{4}$ to $\frac{7}{16}$ inch. Such a bar, when heated, is submitted, endwise, to a very cleverly-contrived punching or cutting press, having a pair of dies furnished with knives, which clip off a sufficient length of bar to make a chair, punch up holes therefrom to form the lips, and make the requisite holes or notches for the fastening spikes. All these actions are performed at one operation in the machine, which may be described as acting somewhat like a steel-pen die, or the self-acting pocket pen-makers, which cut out a finished pen from the quill. The lips or jaws of the chair are formed, as delineated in figs. 1 to 5, by punching up part of the centre of the plate. The outside of the plate is thus kept entire, and the very slight angle which the lips make with the bed of the chair, leaves them possessed of great strength and tenacity. In addition to this, the lips have a large amount of elasticity, serving to hold the keys firm in their places. In some modifications the keys may even be dispensed with, the lips themselves being hammered down to grasp the rails firmly, without any intervening material. The figures show various forms of these chairs, in which some have their lips set sidewise, and others edgewise, to the rails; whilst in one example the two principles are combined. Fig. 6 is a perspective plan of a portion of a line of railway, wherein the sleeper and two chairs are formed out of a single plate of iron. Fig. 7 is a transverse section of a chair, supported on a single sleeper.

By this invention, chairs may be made of malleable iron at such prices, that, whilst the cost of the chairs per mile is lessened, the chairs themselves are actually tougher, stronger, and more easily fitted to the rails, than any other plan which we have yet seen. They have also an excellent bearing upon the sleeper, and are unaffected by frost, like cast-iron. These qualities have led to their extensive introduction into the United States, and the promoters of the lines now constructing in Canada and India will probably find it to their advantage to adopt them for these reasons, and for what is also of great importance—their inexpensive carriage.

RE-OPENING OF THE POLYTECHNIC INSTITUTION.

We have, many more times than once, intimated our imperishable faith in beneficial results from the Great Exhibition. Now that the excitement attending its actual presence is subsiding, and we can reflect in quiet, and calmly see around us things in motion, and others simply indicative of motive power, which, but for the Exhibition, such reflection tells us would never have been, we find that a portion of that faith is already swallowed up in knowledge. It is not alone in the little family circle, where conversation upon the great sight is purposely encouraged to make those impressions deeper, which it made upon the youth and childhood of our homes—it is not alone in the familiar coterie who were privileged to feel, while they saw, the enduring sublimity of the spectacle—it is not alone in the breast of him who "looks before and after," and associates, in indelible unity, all that science and all that art have done, and can do, and rests placidly content amidst the meanest and the greatest things—it is not alone, least of all perhaps in any such, that some of the results of the world's fair are beginning to be experienced. We will not even allude particularly to the watchers without the gate—those who, from any circumstances, were unable to avail themselves of a personal visit, and who, probably, during all the time that others have been staring their eyes out, and wearying every other faculty on the spot, have silently been considering the subject, and learned many truths about it, which we are but beginning to learn. It is but to continue to keep ourselves awake and look around, and abounding in appropriate places we find some of these results. In the metropolitan museums, and repertories of art and science, public and private, the evanescence of the Great Show, in many important educational particulars, is become permanent. On visiting any one of them, we find its stores increased by something or another, and often by immense numbers of things, which are acquiring rank by having been "in the Great Exhibition,"—a rank which, we doubt not, five hundred years hence, will elicit as much, at least, of curiosity, and instruction, and delight, as any antiquary now derives from contemplating a relic of the Roman, or the Grecian, or the Assyrian empires. The very shops are beginning to cry out by isolated beautiful things, which, in the grand emporium, were concealed by the still more beautiful. The Society of Arts—always in its excellent place—has taken up the cue, and bade instructors, best able to instruct, to came forward and speak out a few, at least, of their thoughts on the great subject. Twelve gentlemen have responded to the bidding, many of whose labours have a world-wide reputation, and whose selection, therefore, merits confidence. We purpose noticing these several lectures in order, as they have been, and shall be, delivered. The particular subject, however, which has called forth these few remarks, is the re-opening of the Polytechnic Institution, to which, after its yearly vacation, the boys and girls of the people, and all who delight to take them there, were admitted on the 8th of December.

It is impossible to enter into any lengthened detail of the many articles exhibited. The mention of a few must suffice, coming haphazard as they did upon us, as we paused in our walk through the building. Mr. Stevens again pleases us with a case of dried natural flowers, of smaller size, but no less exquisitely prepared, than those which appeared in that, often present to our memory, displayed on the south gallery wall of the Crystal Palace. Near this is a remarkably beautiful plaster cast, or model, of a white lily. Then we look down into the area, and there see the model of Mr. Mechi's farm buildings. Messrs. Dart and Sons have sent their magnificent specimens of coach-lacemaking; and Mr. Davies has here transplanted his patent self-adjusting carriage-step. Here we observe the new patent marble, and there the new illuminated glass frames—not much to our taste, either of them. Specimens of anaglyptograph printing are again shown, as executed under Bates's patent, and very beautiful they are. Fac-similes of imitative art and early printing—very true; electrotyped copper-plates, and impressions from them; and many of Captain Ibbetson's fine specimens of this interesting process claim, in this new locality, a longer notice than they did in the dark corner assigned to them under the Hyde Park Glass Shade. Curiosities, too, abound. We saw a well-executed sketch, drawn with fossil sepia, exhibiting a tone of colour almost identical with that obtained from the cephalopod of the existing seas; hairs from the head of an infant, with a needle's eye punched in each, the end threaded through and knotted! and the Chinese temple, constructed very ingeniously of the pith of wood, exhibiting an elegance of design, and delicacy of handling, which the artist is probably at this moment using with additional power. Hutton's patent clock is here, with its elegant glass pendulum, one of the few philosophical applications of that material. The prize specimen of the golden flax satin damask, with its elaborate designs from the Portland Vase, is again to be seen here. The process of the manufacture of china is shown in detail; and a large cabinet of Chinese singularities forms no unimportant addition to the wall cases, upon the tops of which a series of busts are still arranged, with a large new collection of stuffed birds. Many of our old and familiar friends again greet us as we pass along. While some may gaze upon minerals or fossils,

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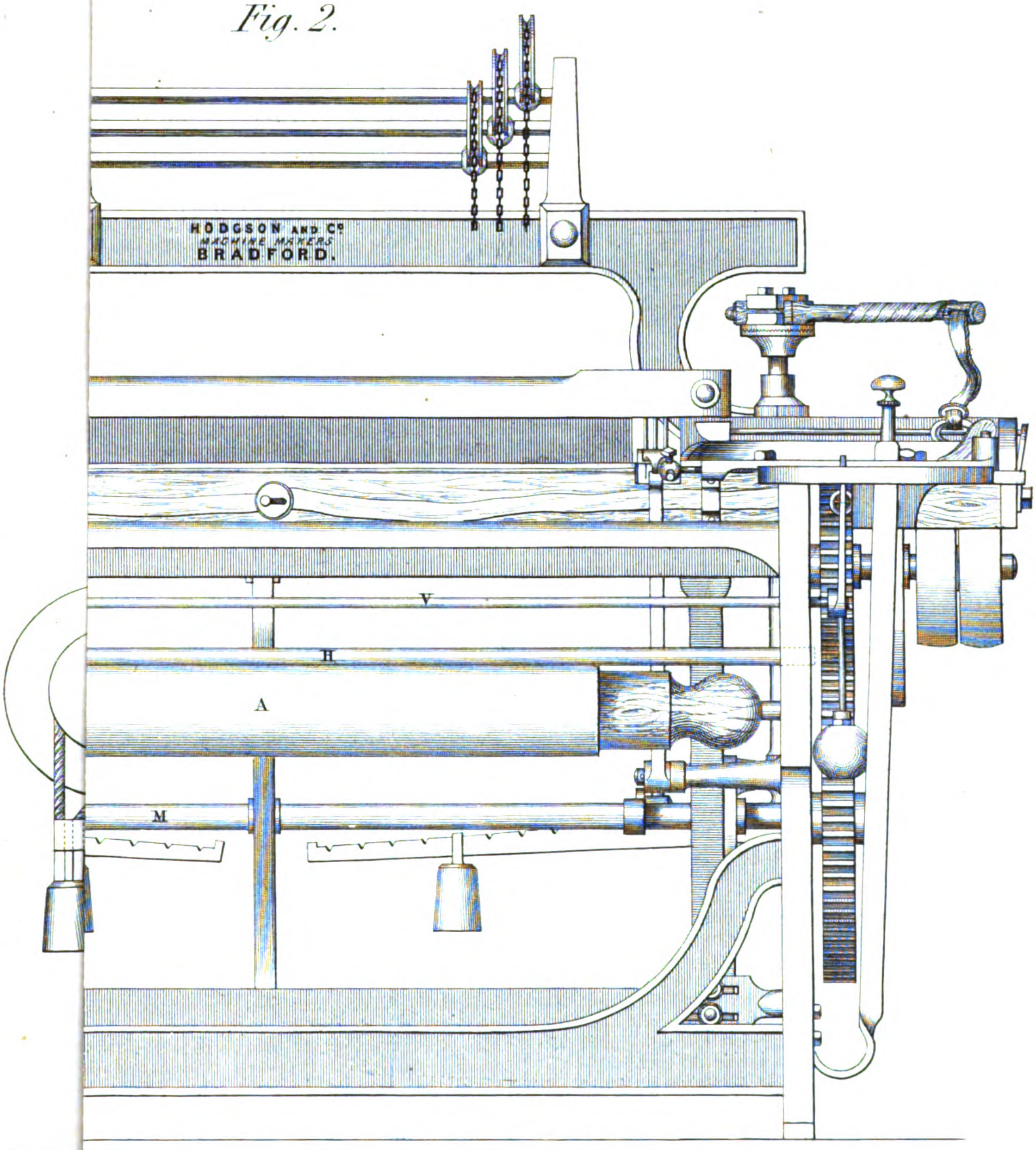
Vol. IV.

Fig. 2.



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others may be amused or instructed with the diver and the diving-bell. The glass-blower, the blind wire-basket worker, the cotton-twiner, the seal-engraver, are all once more plying their various arts. The fat man and the thin man may both be weighed and found wanting, and the short and the tall may wage a battle of heights. Arranged along the outside of the gallery, on brackets, are cases with wax flowers; and one side of the great hall exhibits, under glass, figures representing the Sun, Mercury, Venus, the Earth, and the Moon, all of relative size and distance—a new and interesting, as well as instructive addition—very appropriate here, but yet more so in the museum of practical geology, where, on a recent visit, we find the same placed.

Characterising this institution, however, above all these things, the popular lectures on science and art take their daily place; and Dr. Bachhoffner's and Mr. Pepper's philosophical manipulations, and Mr. Chatterton's melodies on the harp, continue to draw forth gratifying murmurs of delight, or more noisy demonstrations of approbation.

We can only say, in conclusion, that this Corporation (whatever may be thought of its fellows "not a hundred miles off") well merits the success which appears to have attended its hazardous career, and to be entitled to look forward to those substantial rewards, a harbinger of which appeared in the crowded benches on the opening day.

MILLIGAN'S POWER-LOOM.

(Illustrated by Plate 88.)

This important invention will be remembered by many of our readers as having been shown in Class 6, No. 38, Great Exhibition; and it may also be interesting for them to know, that our illustrative plate has been prepared from actual drawings made from that loom as it stood in the Crystal Palace.

The loom is the patented invention of Mr. Wm. Milligan of Bradford, who has accomplished in it the desirable objects of putting any number of picks into a given length of warp, whilst the number of picks are capable of variation without the use of change-wheels, or the alteration of the weight on the yarn-beam, so that the warp may be kept as tight as its strength will bear, without involving any unevenness in the woven fabric. It has an advantage over all friction motions—that it will neither slip nor fray the cloth, and weaves wet weft as well as dry.

Fig. 1 on our plate is a complete side or end elevation of the loom in working order, looking on the "taking-up motion" side; and fig. 2 is a corresponding longitudinal or front elevation, that is, looking on the cloth-beam side. The cloth-beam is at A, being carried on a spindle supported in a slot in the side standards, on one end of which spindle is a spur-wheel, B, outside the frame, in gear with the pinion, C. This pinion is carried on the fixed stud-shaft of the wheel, D, and moves along with this wheel, which again is in gear with a pinion, E, carried round along with the ratchet-wheel, F. Immediately above the cloth-beam, and resting upon the fabric in the act of being wound thereon, and with its ends supported in vertical slots, G, in the loom side-frames, is a horizontal rod, H. This rod, as it bears freely upon the folds of cloth on the beam, is gradually elevated in its guide-slots by each additional fold of the cloth, as the beam takes up the fabric by its slow revolution. The end of the spindle of the cloth-beam has also upon it a loose bent slotted lever, I, standing up at a slight inclination with the vertical line, and behind the rod, H. This lever has an adjustable pin in its slot, to which pin is jointed one end of the link, J, the other end of which is similarly connected to a slot in the upright lever, K, behind. This lever is connected, as we shall hereafter explain, with the eccentric tappet, L, keyed on one end of the tappet-shaft, M.

When the loom is in action, as the horizontal rod, H, of the cloth-beam gradually rises from the accumulated folds of the cloth beneath it, it presses against the inclined side of the lever, I, raising it by degrees to a vertical position. By this action, with every slight advance of the lever, I, towards the vertical line, it thus pushes back the lever, K, by the intervention of the connecting-rod, J, so as to shorten the extent of the traverse of the lever, K. The latter lever works loose in a fixed stud centre, N, in the side-frame, and, thus suspended, it is connected by its straight pendant end, or lower arm, with the wheel-work which we have just described, and by its back angular arm, with the eccentric tappet, L, on the same shaft as the ratchet-wheel, F; and outside this wheel is set the regulator, O, the lower eye of which turns loosely on the ratchet-shaft as a centre. This regulator is simply a slotted lever, having a sliding piece, P, set to move up and down in the slot; and at its upper end is a short collar, acting as a bearing for the upper end of a screwed spindle, Q, the lower opposite end of which is passed through a screwed hole in the sliding piece, P. In this way the sliding piece, P, answers as a nut for the screw, Q, and the turning of the screw consequently allows of the raising or lowering of the nut or slide piece at pleasure. To the top of the regulator are hinged three detents, R, each of which takes into the teeth of the ratchet-wheel, F. On first setting the loom to work, the height of the slide-nut, P, of the regulator, is first adjusted to suit the required number of picks to be laid into the fabric per inch, and the regulator and lever, I, are pushed forward by means of the lever, K, as far as the rod, H, will permit. When the loom is put in motion, the eccentric, L, during one-half of its first revolution, presses against the projecting angular end of the lever, K, and pushes it out to an extent equal to its eccentricity, whereby the regulator is drawn back, to a corresponding extent, by the connecting-rod, S, whilst the detents, R, bring round the ratchet-wheel, F. During the remaining half of the revolution of the eccentric, the angular tail of the lever, K, descends as far as the then degree of elevation of the cloth-beam rod, H, will permit, and the detents, R, are raised out of their position, and lifted as many teeth back as is equal to the distance re-traversed, the three detents, T, suspended from the centre of the wheel, D, serving to hold the ratchet-wheel fast whilst this change occurs. It will thus be seen, that whilst the detents, R, are always drawn the same distance during one-half revolution of the eccentric, the distance to which they are returned in the other half revolution must be less, as the cloth-beam rod, H, is raised higher by the winding on of the cloth. The lever, I, should be parallel with the slots in which the rod, H, works, when the projecting end of the lever, K, is elevated to the top by the eccentric, L, and it should rest on the rod, H, when the eccentric is down.

At U, is a short lever connected with the weft-motion of the loom, which lever raises the detents, T, by means of a chain, off the ratchet-wheel, to stop the movement when the weft breaks. The lever, U, is fast on one end of the horizontal rod, V, on the other end of which is a balanced lever, worked by the weft thread, on the principle of the ordinary well-known weft-stopping apparatus.

The practical manufacturer will at once perceive the peculiar elegance and accuracy with which the points we have attempted to elucidate are carried into effect.

PATENT LAW AMENDMENT.

Under the title of "An Act to simplify the forms of appointments to certain offices, and the manner of passing grants under the Great Seal," patentees and inventors will be surprised to be informed that their interests are advantageously affected.

By this act, which appears to have passed without the public being aware that their interests were by any means concerned, several of the most objectionable stages in passing English patents are dispensed with, from and after the 1st of January, 1852, and considerable delay, which was altogether useless, will be thereafter avoided. Our readers are, no doubt many of them, aware, that in passing an English patent, numerous offices in different parts of the metropolis had to be visited, a considerable amount of badgering had to be undergone, and (worst feature of the case to a poor inventor) large sums of money had to be paid in each. We cannot say that all this is now avoided, but as by this act several of the most absurd and useless steps have been abandoned, we may hope that others will follow, and that further reductions of fees will also be made. To explain exactly to our readers what these alterations are, we must run through the heads of the several stages as they existed in the bygone year, 1851. Presuming a petition to have been signed at the Chancery Affidavit Office (if in London), or before any master-extraordinary in Chancery in England, or before a justice of the peace in Scotland, this petition had to be forwarded to the office of the secretary of state in Whitehall. From his office it was taken to the attorney or solicitor-general's chambers in the Temple, or Lincoln's-Inn. When the attorney or solicitor-general had made their report in the matter, then the petition and that report were again taken to Whitehall, for the preparation of a document called the Queen's warrant, which was signed by her Majesty, and countersigned by the secretary of state. This Queen's warrant was then taken to an office of the attorney and solicitor-general, in Serle Street, Lincoln's-Inn, where a patent bill was prepared and signed by the attorney or solicitor-general. This patent bill was then again sent to the Home Office, her Majesty's signature to it being an essential requisite. When so signed, the bill, then having become the Queen's bill, was sent to an office in Abingdon Street, Westminster, to receive the signet from the Signet Office. It went to the Privy Seal Office, to be sealed with the privy seal, and the privy seal bill forming the authority to the lord chancellor to affix the great seal, it was afterwards taken to the Great Seal Office, in Quality Court, Chancery Lane, where the letters patent were sealed.

The present act shortens these proceedings very much, by dispensing altogether with the patent bill, Queen's bill, signet bill, and privy seal

bill; and enacting that, in the place of these proceedings, the only authority to be required by the lord chancellor for affixing the seal to a grant of letters patent, shall be a warrant prepared by the attorney or solicitor-general and signed by her Majesty, countersigned by the secretary of state, and sealed with the privy seal. The two first stages—the reference from the secretary of state to the law officer, and his report—will remain. The great delay in the procuration of English letters patent will thus be avoided to some extent, and if the act is fully carried out, a very considerable reduction in the cost will also be made; but we regret that, as the rules of the attorney and solicitor-general are not yet issued, we cannot state what the reduced fees will amount to.

We propose to furnish our readers with a reprint of the rules, or such portion of them as will be useful to general readers, in our next publication, and we shall then also be able to give a statement of the amount of reduction of the fees, which, it is generally understood, will be a little more than £20. In the meantime, any of our readers personally interested in the matter, may obtain exact information, by post, on application to any of the Editor's offices. I. H. I.

PHILOSOPHY AND PRACTICE OF RAILWAYS.

I.

We are "practical mechanics;" that, and, we trust, more also. We regard mechanism as a means, but not an end. Every new invention is valuable, in our estimation, in proportion either as it may diminish human drudgery, or add to the amount of human happiness, in extended enjoyment of all the faculties God has bestowed on us to use and not to abuse. The great mechanism of the globe we inhabit was given for man's universal race; and the smaller mechanisms we work by powers borrowed from the great mill-stream of the universe, should be made to work more and more each day for the benefit of the many, with wise progress, till drudgery be extinct, and the poor shall wholly cease from out of the land, save only those who are born poor, and must remain poor by reason of natural disability of faculties; even those becoming fewer and fewer in every succeeding generation, by the extirpation of the motives to crime, which bear seed in curses to "the third and fourth generation."

Our knowledge is vast in amount—not mere book-knowledge—treasuries of recondite printed lore—but knowledge written on the brains, stamped on the hands, of multitudes. We have realised the dreams of Eastern romances in a working-day world: we can drift through the air, we can swim on the surface of the deep, we can bowl over the surface of the earth, at speed that mocks all animal nature; we can convey thought on the wings of hidden fire through the air or through the deep; we impale the lightning for our watch-lamp, and bid it point out distant worlds; we build palaces by magic, and ransack all nature to adorn them, and fill them with luxuries; yet with all this, there are multitudes of our fellow human beings whose souls are starved, and whose bodies and faculties are deteriorated by living in immoral and unwholesome dens, where no beautiful form or colour moulds their perceptions or tastes, where nothing exists to cultivate an intellect higher than cunning, and where they feed on coarse garbage that helps to foster the body's coarseness also. The work of the world has been done by the many for the use of many, but it has still left multitudes without the pale of civilised humanity.

We are not croakers—we have none of that spirit which professes to see all virtue in the poor, and none in the rich. On the contrary, we think the rich ought to be, and probably are, as a body, more virtuous than the poor—if that can be called virtue which is a result of absence of temptation. And we think that, if the rich could be forced to live more face to face with the poor—could be made to perceive their miseries, they would seek to alleviate them, from the mere desire to get rid of the uncomfortable sensations they would stir up. They would be inclined to remove their miseries as a nuisance, as boards of health are made to stir when fever in poor quarters overflows with its contagion the habitations of the rich. Bad habits, bad manners, bad customs, would not endure, if brought face to face with good ones. The change for the better wrought on working men, by riding in the same omnibuses with those who are better clad and educated, they can themselves hardly appreciate—it is silent education, that makes no show. But for this universal circulator, many would never have had the opportunity of witnessing the manners of the easy classes; and but for this, the easy classes might not have learned that the workman, as well as the employer, may be a gentle human being, though clad in a coarse exterior.

Have any of our readers seen Dickens' 'American Notes,' where he describes the smoking, chewing, and expectoration of the steamboat passengers? If not, let them descend the Thames with a Gravesend or Greenwich steamer on a fine Sunday. There he will witness precisely the same scene. It is almost impossible for a person who loves not tobacco, and lives on weekly wages, to obtain fresh air on the water. Why should this be? Why should our senses be at the mercy of tobacco-smokers more in a steamboat, than in an omnibus or in a railway carriage? We think it arises from the fact, that there is a less fusion of classes of society in the Sunday steamers. And how much of this propensity to an opiate disagreeable to many, may be traced to the habit of living in a bad atmosphere, or the want of sufficient mental stimulus? Many a workman, lacking a wholesome dinner, smokes in lieu thereof; and what was first a result of necessity, grows into a habit.

We dwell upon this, because long experience has convinced us that locomotive travelling, more than any other thing, conduces to true education. The philosophers of old are distinguished as men who had travelled. It is true, that in those times, lacking books, there were no other means of gaining knowledge; but with all our modern appliances of printing, nothing is effected comparable with the knowledge—the impressed knowledge—acquired in our modern mode of travelling. It is to railways, more than to any other thing, that we owe our present rapid progress. Ignorance cannot long dwell by the side of a railway, though a narrow view of self-interest may deny the full use of the railway to those who most need it. Whenever we hear a sweeping condemnation of the evils resulting from competition, still we see in that competition the only means whereby the masses can be made partakers of the general knowledge, whereby the gifts of nature may be distributed to all alike.

We hear much of the great facilities for travelling on our English railways, but these facilities exist chiefly for the rich, or for those in easy circumstances: the poor lack these facilities. If a rich man wishes to leave London, and travel two hundred miles, transact his business, and return to London in one day, and at convenient times, he cannot do so at less cost than fifty shillings; and this was the case at the time the cost of transit between London and Leeds and back (four hundred miles) was seven and sixpence. Is there any mode of persuading the directors who hold the monopoly, to carry passengers at a moderate profit, since the competition looked forward to from the Great Western? There is really no mechanical or commercial reason why poor men should be denied the same facilities as the rich in what relates to transit, yet it seems a line of providence that only competition shall bring it to bear.

Yet are the directors who do these things—seeking a large revenue from little work—neither better nor worse than many professing to be working men. We have now lying before us a circular, addressed by the "Members of the Amalgamated Society of Machinists, Engineers, &c., to their Employers," emanating from London. Upon the assumption of the truism, that the absorption of a man's whole time in hard work, without relaxation or time for thought or study, must be injurious to his mental and physical health, they give notice that they, the Executive Council, promulgate a decree "that henceforth there shall be no more piece-work, and no overtime whatever, save in cases of 'breaks down,' when double time shall be paid." Anything more monstrous than this interference with individual freedom of action, more utterly destructive of all progress, more effectually shutting the door to the advance of the working man, more hopelessly condemning him to a condition of caste for ever, could not well be imagined. That there are evils, and painful evils, in this transition state of competition, is but too true; but no amount of evil from that source is comparable to the wholesale misery that would be induced by interfering with the freedom of individual action. The springing temperament that elevates humanity would depart, and we should shrink into sloth and torpor like that of oppressed slaves. Our English workmen would become a mere unit with a number—like a Siberian serf; he could achieve no distinction—never rise above the toil indicated from his birth. He would be the antipode of the American workman, who acquires his skill and shrewdness by free trade in his own labour, changing from employment to employment, till he finds that for which he has the greatest natural aptitude.

The chief cause of human misery is probably the misfitting of persons to their employments. A man cannot thrive at work which is distasteful to him, and all human beings in health have an aptitude for some kind of work. It may be said, probably with truth, that only one-fourth of the community gets really to work, after bearing down opposition, while the other three-fourths are merely striving to impede each other. The practical meaning of the term competition, is an ignorant striving to know what each man is really best fitted for—to apportion the tasks of society. A man struggles long, finds his position, and then the struggle ceases. Education would remove much of the necessity for this—such education as would enable a youth to see many things, and try many things, in his early years. The "division of labour" was very useful while we were a nation of *manufacturers*, but every day beholds our *manufactures* lessening and our *machinefactures* increasing. But even on the

score of production, the minute division of labour is not profitable. The maker of pins' heads is a drudge—weary and nerveless. He has no mental stimulus; and he seeks physical stimulus, and his life is shortened. Change of mental stimulus—change of physical employment, is as essential to the human being, as change of amusement or change of food. It may be true that great skill is acquired by constant attention to only one thing, as great skill is acquired by college students in preparing for an examination, the result of which is frequently destructive of the mental powers. There are certain employments that individuals naturally take to of several kinds analogous to each other. Thus, a worker in wood will become a more skilful workman, if he work month about at chair-making, at cabinet-making, at carpentry, at joinery, and so on. No more skilful men can be found than pattern-makers, for this reason—their minds are cultivated by varying forms of matter, and their faculties are stimulated. To say to such as these—"So many hours a day and no more shall ye work, for ye know not of yourselves the thing that is good for you," is an insult to their understandings. We can only conceive that those who promulgate such plans, are men who have mistaken their vocation in life, and wish to prevent others from being more thriving than themselves, or wish to live on the earnings of those more skilful men.

In the prodigious development of skill and progress that has taken place of late years, nothing has played so important a part as railways. We hardly know now which we could best spare, the press or the rails. The railway has created so many new trades and arts, that the ancient monopoly of guilds and seven years' apprenticeships seems to be at an end. Every day brings forth some new art, or change in art, by the facilities which machinery offers, not requiring the mere dexterity of the fingers; and therefore men can change to them from analogous employments. And not merely in the increase of new varieties of employment, but also in the comparative facility with which many classes of the community can get to behold, inspect, and become familiar with such employments, are railways the great teachers of the community. And were they rightly developed, they would equalize the value of labour as well as commodities throughout the country; *i. e.* they would prevent the superabundance of workmen in one district, while there was a lack in another at the same time. They would prevent change of residence in search of work, from being so great a risk as it is at present. They would amalgamate districts and assimilate manners and customs, not as a mere matter of curiosity by excursion trains, as at present, but as an every-day habit, and with more profit to the shareholders; for excursion trains do, in truth, involve extra cost to a railway, just as overtime involves greater expense to a factory. When there shall be freedom of circulation within the means of all working men, and freedom of change of employment from one branch to another, according to the aptitude of each individual—not confining them to employments distasteful to them and hurtful to the community—the result will be a much larger production with less labour, and Trades' Unions—ever a grievance to the best and most intelligent workmen—be no more.

In the present state of the world's progress, all new discoveries, involving skill and labour, must necessarily be prosecuted by a comparatively small number of individuals; and they prosecute such discoveries for their own pecuniary profit. They do not seek the public advantage, save contingently, as a circumstance which is essential to their own profit. The maximum of profit to themselves is their definite object, and there is a short-sighted propensity to wish to get a large profit from a small business, rather than a small per centage in a large business. With this we cannot find fault; the law of national progress is, that general profits are made up of the results of individual energies, and they are stimulated by individual gains. That the individuals may be shortsighted to their own largest interests, that they may not exercise a wise discretion, is simply saying that the world is as yet but partially educated. Nothing but the principle of competition can correct this evil.

Railways were first made by companies in competition with highways. Large profits were made, and further competition was stimulated. It is now sought to prevent competition by amalgamation, in the hope of maintaining high fares. This cannot be effected. It is as absurd as the recorded attempt of the "wise men of Gotham to hedge in the cuckoo," in their attempt to catch it. Were it a question of canals, the thing might be practicable, because providence has limited the supply of water, save, perhaps, in the low parts of Holland, and therefore the owners of canals might have set competition at defiance, had not railways been invented. But railways are as capable of multiplication as streets or ordinary roads, and ultimately they will become practically our streets and ordinary roads; and therefore the value of railways must be ultimately determined by the value of the property they pass through. If the rates be exorbitant, the owners of the property will ultimately prefer making their own railways, as they now make streets through new building estates. That there will be railways required for rapid transit by the shortest distance between distinct places, is quite clear; but these will not compose the mass of railways; and whenever fares get too high, the traffic will depart to numerous parallel lines, formed for local purposes—lines made, not for specific profit, but for the purpose of giving value to the property on their borders.

At the outset of railways, builders avoided them as a nuisance. They now seek them. But the true use of the railway cannot be developed, till a more comprehensive view is taken. The original dwellings of mankind were located along the banks of rivers, where water communication existed. The subsequent roads pursued the same track. Other towns were placed near good land, or at seaports; but in all cases, as soon as the roads connecting them were made, houses began to spring up along their borders. In all cases, these houses were erected where water was to be found. Dwellings cannot exist without water. Therefore railways, as at present constructed, are at a disadvantage as compared with streets or general roads. Were a water-main led through their whole length, they would be available for dwellings through their whole length, and for factories also. Towns and streets, as at present arranged, have the advantages of water and gas, and the disadvantage of inferior modes of transit. The railways, on the contrary, have the advantage of superior transit, but they have neither gas nor water, save for their own purposes. They offer none to the public, though with every facility for so doing. Let them once accomplish this, and let them also digest some system of insuring to the public that they will not be overcharged, and their property will be secure. The proposed plans now coming before the public for laying down rails in the streets and roads, and which must sooner or later be in operation, have to provide only the superior transit to the existing supply of dwellings, factories, gas, and water. And if this be not done, it is very certain, that gradually London, and many other towns, will have to "go out of town," as Northampton did, when it eschewed the London and Birmingham line. Existing towns have, for the most part, the advantageous sites; but just as Brighton became the gateway to the continent, when no Dover railway or Calais railway existed, so will traffic and dwellings leave London, and go to inferior sites, if superior transit be not provided for them.

Henceforward many railways will be made by individuals and the inhabitants of localities, less for the sake of profit as a railway, than for the benefit of neighbourhoods. If the example be once set, of laying down rails in streets and roads, these rails will be continued to many a new building property, and will gradually make way over all the turnpikes and highways, through all the farms and villages. The fact that, in the United States, lines of railway are carried through streets, must have its weight in producing the same results here; and the only question that could arise, is the disabling the roads for ordinary traffic. The fact once clearly shown in one example here, that a turnpike road is applicable to both purposes, just as much as the commercial road has been for years applicable for ordinary traffic and as a tramway, will settle all further dispute.

In our agriculture—now imperatively demanding improvements—the great element is roads of cheap, and easy, and rapid transit. The means are required to get manure into every farm, and to get produce off it. A farmer cannot work with the maximum of profit, until he can load his railway waggon on rails in his farm-yard, and transport it by steam, without shifting his cargo, till it arrives in the market of the town or seaport. What constitutes the enormous difference in value between a turnip in the farmer's field, and the same turnip in the kitchen of a town consumer? Transit alone. And the result is, that workmen in towns eat but few turnips, and scarcely any vegetables but potatoes. Vegetables in towns are expensive luxuries, never supplied to anything like the extent of the consuming power; yet a variety of food is essential to the health of the "practical mechanic." Tools and a workshop are not all in all. He should eat wholesome food day by day, as he should get wholesome air from time to time, or the general community will suffer by it as much as himself. With regard to change of labour also from time to time—the labour of the workshop, to the labour of the field and farm, with a view to the best development of the working faculties—there is much yet to be thought of; and it is quite certain, that the mechanism of various kinds, which has still to be applied to agriculture, can only be applied by the agency of the rail. We talk of our railway system, but in truth we have no system. We have certain railway habits, which have grown up as each necessity presented itself; but altogether, things wear as much the character of after-contrivances as of forethought. There is a general feature of road with a harder surface, with trains hauled by steam locomotive engines of enormous power, but in other particulars much is wanting. The wide-spread capabilities of these new features, these general applications, sure to replace the old means of transporting passengers and goods, seems hardly dreamed of.

We therefore propose, in a future number, to deal with this, treating the railway system as a whole, and not as a series of private trusts. A "practical mechanic," before he erects an engine, endeavours to secure a good foundation. Railway extension is again before the public, and clear views are desirable, to prevent waste of means.

MOTOR.

MECHANIC'S LIBRARY.

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RECENT PATENTS.

MANUFACTURE OF FACTITIOUS LEATHER.

P. WEBLEY, *Birmingham.—Enrolled October 30th,* 1851.

The invention, from which we select this branch, comprehends the three several heads of "a method of nailing or pegging the heels of boots and shoes"—the manufacture of a new material, termed "compound leather"—and "a method of rendering boots and shoes waterproof." We shall meanwhile enter upon the second head only. The factitious material to be used as a substitute for ordinary leather, is prepared from scraps and waste parings of leather, which, in the first instance, are steeped for some time in warm water, for cleansing. They are then removed, and partially dried by centrifugal machinery, or other desiccating apparatus, and are afterwards placed in a solution of size or glue, until thoroughly saturated. In this saturated condition they are arranged flatly and evenly on a metal case with an open top, the bottom and sides of the case being perforated to allow the moisture to escape. The case so filled is then brought under a powerful press, the pressing-plate of which exactly fits into the interior of the case, and compresses the pieces into a compact mass, at the same time expelling the superfluous moisture contained in them. When removed from the press, the mass is dried, and is then reduced to minute particles by rasps and cutters in a machine specially contrived for the purpose—such raspings being afterwards treated with hot water, to dissolve the glue previously applied. When the material is well softened, it is removed in a pulpy state, and washed and dried by centrifugal machinery. In this state it is spread out on wire-gauze trays, set in heated chambers. When well dried in this way, the treated matter is to be mixed with gutta percha or caoutchouc, or a combination of these two substances. The gutta percha for this purpose is softened, by being placed in a steam-heated pan, and the dried pulp is added to it, and thoroughly incorporated with it by means of an agitator. When the mixture is completed, the bottom of the vessel, which is formed like a piston, is made to rise up, bringing with it the compound mass, which exudes from a suitable channel, and is passed between rollers to bring it into the state of sheets.

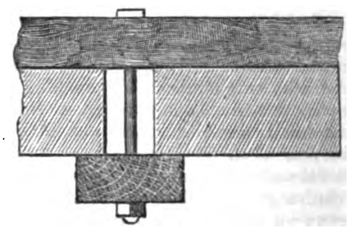
The newspapers lately contained notices of a factory having been established in the United States for the manufacture of a factitious leather, but we believe the system we have just described is the only one really and gravely proposed.

PERMANENT WAY, PAVING AND FLOORING, ROOFS AND BRIDGES.

W. BRIDGES ADAMS, 1 *Adam Street, Adelphi, London. Enrolled Dec.* 3, 1851.

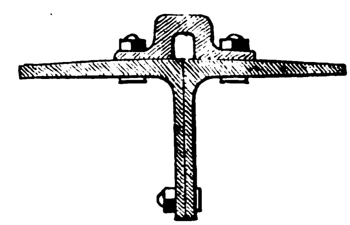
Mr. Adams' improvements in permanent way are of several kinds. First, a mode of rendering available the old stone blocks, which are, chemically, the most durable material, by providing elastic action through the medium of transverse or longitudinal timber sleepers, bolted or screwed to these blocks in such a mode that the loads will not displace them, and the blocks will act as true ballast to the rails, preventing their springing up under the trains, as is the case with mere surface-laid sleepers. Any kind of rail of the chair or bridge kind may be applied on the timber sleepers, which may be kept wholly out of the ground and free from rot, the stone blocks being bedded to the level. In this mode the ordinary ballast may be dispensed with. The elasticity of the timber will thus be rendered available without disturbing the substratum. Fig. 1 shows one mode of several for accomplishing this object.

Fig. 1.



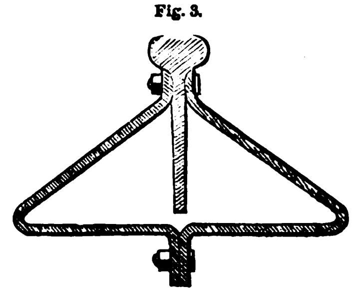
Secondly. A novel construction of rails for permanent way, denominated "girder rails," of which numerous examples are given. The object is to attain sufficient vertical and lateral stiffness, with abundant bearing surface, so that these rails may be placed in and on the ballast without needing sleepers, and requiring only tie-rods to determine the width of guage. These girder rails may be rolled in one piece, or may be composed of several pieces built together, as shown by fig. 2, the parts breaking joint with each other to prevent any loose movement. If required for curved lines, each portion may be separately bent, and being thus bolted together will maintain its form. Upwards of sixty different varieties are shown, but the one we give embodies the principle. The horizontal portion of the rail lies on the surface of the ballast, while the vertical portion steadies it, like a deep keel, against the lateral lurches of the engine, and prevents deflection or disturbance of the ballast. This rail is very easily packed.

Fig. 2.



Thirdly. A novel construction of rail, to be used without sleepers, composed of parts, for the purpose of permitting as much vibration of the surface under the rolling loads—yet without mischievous deflection—as will prevent destructive wear, and at the same time keeping the bottom of the rail firm on the ballast, without any deflection whatever. It is obvious that, in the ordinary modes of constructing railways, all deflections of the rail must be accomplished by disturbance of the ballast, requiring constant repacking. Fig. 3 shows this arrangement, but several varieties are given. The bottom lies flat on the ballast. The upper portions, at the sides, can deflect slightly, while the rail, by reason of its depth, will be subject to little deflection, and in case of a very heavy load, would take a bearing on the bottom. The portions are put together "break-joint."

Fig. 3.



Fourthly. A novel mode of railway drainage, by converting these hollow girder rails into drain-pipes, by perforating them in parts, so that the water may flow into them, and be led away at intervals. To prevent rust, the inventor proposes to galvanize or bitumenize the rails.

Fifthly. A mode of constructing elastic permanent ways to be used in streets, or on arches, or the tops of buildings, to prevent noise and

vibration, by means of several courses of longitudinal balks, placed one above the other, and separated by blocks at intervals.

Sixthly. A mode of constructing portable railways for farms and other purposes, the rails being sectionally cruciform or angle form, to be used without sleepers, and connected by iron cross-bars to form the guage, notched into the rail ends, and secured by staples; such staples being made of differing span, when required, to keep the outer rails more apart in length, to form curved lines of way.

Various adaptations of engines, carriages, and waggons, are also given, adapted to these and other railways.

Seventhly. A novel mode of constructing roofs and floors, applicable to railway and other buildings, by a network of tension chains or bars in links, disposed at right angles, or several angles, with an arrangement of cruciform girders above them, and connected to them, so that the girders will form a compression system, and the chains a tension system; and thus a rigid floor or flat roof will be produced, the strain of which will be self-contained, and equally distributed on all sides, and the stress on the walls will be reduced to simple vertical pressure on all four walls alike, supposing the building to be quadrangular. The chains may be set up by screw-bolts to camber the roof, or wedges may be inserted between the girders to accomplish the same purpose. This kind of floor or roof is very susceptible of ornamentation, and may resemble a groined ceiling in its general effect. When used as a roof, it is to be glazed with large sheets of cast glass, slightly convex, and with the edges turned down, to fit in the compartments of the roof, in the mode of a ship's hatch. Elastic cords or piping of caoutchouc or gutta percha, or similar material, are to be used to caulk the joints, and such cords are applicable to the joints of stonework also.

Eightly. An improved mode of constructing girders for bridges or other purposes. These are "box-lattice" girders, erected on tension chains, so as to render such chains rigid structures. The chains being formed of links in the usual mode, but with the eyes thickened to twice or thrice the intermediate substance of the central portions of the link, to prevent cutting the bolts or crushing the eye, are drawn across in the usual mode, from pier to pier, by slinging the links successively to ropes, increasing the number of links towards the centre, to equalise the strain. Two or more chains being thus drawn across, are anchored at each end, with provision to tighten at pleasure by windlass of sufficient power. The bolts which connect the chain-links are longer than usual, by reason of the greater thickness of the link-eyes, and sufficient length projects beyond the outer links, to receive the diagonal struts forming the lattice with the nuts beyond them. The chains being drawn across them, shear-legs are erected at about the centre, to draw up two of the links on each side to a horizontal line. The diagonal lattice struts being then applied on each side, the chains are connected to a top coping, and the nuts are screwed tight, when that portion of the chain will form part of a rigid girder. The chains being moved on, another portion of diagonal lattice is added, till the whole is complete. At the intersections of the lattice's distance tubes are introduced, through which pass screw-bolts, connecting both lattices together; and thus the bridge or girder may be erected without any centering whatever, and it will be rigid vertically, and will not be subject to buckle laterally, as is the case with ordinary lattice bridges, by reason of the strength given by the double lattices and the distance between them, which may be increased by washers between the link eyes, to widen the chains, and especially at the middle portion. And in this mode, small scantlings of iron will possess additional strength.

Ninthly. An improved mode of constructing footways or pavements of perforated materials, so as to permit mud, dust, or water, or other extraneous materials, to pass through to an under surface, which may be pitched at any desired angle, while the upper perforated surface may preserve a horizontal level. The material preferred is cast-iron, recessed on the surface with asphalte or bitumen to prevent slipping, and the recesses may be ornamented with coloured mosaic tiles or other ornamental work. There are various modes and varieties of this shown, and the general plan the inventor prefers, is to form perforated stools in the form of a square yard, divided diagonally into four parts, each standing on three legs, one at each corner, about four inches high from the ground or under surface. The four stools being placed together, the four legs unite in a cup or shoe, and similar cups or shoes being placed at the other corners, corresponding stools may be united to any extent. The under surface may be easily cleaned by passing a rake below from the curb-stone, or by lifting the stools. This kind of paving may be applied to floors and passages in buildings, and, with various modifications, to garden and other walks, as an improvement on the ordinary gravel, either laid in contact with the surface, or raised above it. It may also be applied in various modes to the purpose of advertisements.

As these improvements relate to very important subjects, we shall enter on a critical examination of them in our future numbers.

BRUSHES.

THOMAS HAWKINS, *Inverness Terrace, Bayswater, London.*
Enrolled September 24, 1851.

This elegantly simple invention relates to the more effectual securing of the bristles of all kinds of brushes, but more especially those used by painters and colourists. Fig. 1, of our engravings, represents an external elevation of a painter's brush, as made by Mr. Hawkins; and fig. 2 is a partial longitudinal section of the same. The bristles are drawn through a conical metal ferrule, A, their ends being cemented in the usual way; or a coat of gutta percha solution may be first applied, and then the ordinary cement—the conical shape of the ferrule admitting of their being most effectually tightened, simply by drawing them more or less through it. When this is done, a flat metal cap, B, is soldered on the wide end of the ferrule—this cap having secured upon it a slightly conical socket, C, to receive the thicker end of the ordinary tapered wooden handle, D. The conical form of the socket, aided by the side rivets, E, obviously precludes all chance of the handle getting loose. If any space intervenes between the ends of the bristles in the ferrule and the cap, this is filled up solid with cork parings, as at F. By this system of connection, a great saving is effected in the length of the bristles, as half an inch is enough of hold for the ferrule, whereas more than double that length is necessary on the lapping system. Great economy in actual wear is also secured, inasmuch as the bristles may always be worn down to the stump, still leaving a compact face, which, in the common construction of brushes, is destroyed by the thick end of the handle protruding through. For hot climates, the patentee deems his brush to be essentially suitable, as the metal ferrule protects the cement from the heat.

Fig. 1.

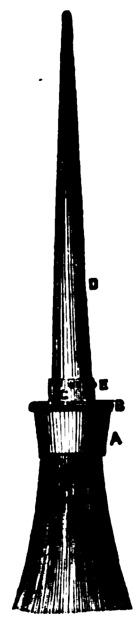


Fig. 2.

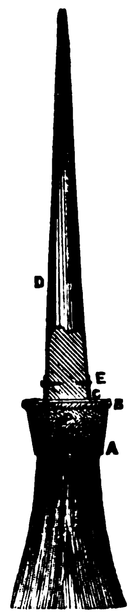


Fig. 3 is a side elevation of a colourer's brush, and fig. 4 is a partial longitudinal section corresponding. In this form of brush, it is not necessary that the metal ferrule, A, should be conical or taper, as the bristles are securely held by the rounded shoulder, or rim, B, formed by doubling the metal round a piece of wire of suitable thickness. After the insertion of the bristles, the sides of the ferrule are squeezed together in a vice, to bind the whole well together, when cement may be applied as before. The flat handle is then to be inserted into the upper open side of the ferrule. For this purpose, it has a groove cut all round its lower end; and on insertion, the upper shoulder, or rim, E, enters this groove, thus preventing the handle from either getting too far in, or being pulled out. It may also be further secured by screws, F. The shoulders clasping the bristles may be held together, if necessary, by small rivets, G, running through to each side.

Fig. 3.

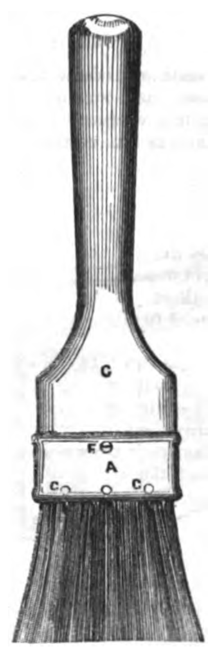


Fig. 4.

Mr. Hawkins has delineated various other forms of his brushes, but the two examples we have selected will be sufficient to show the nature and extent of his improvements.

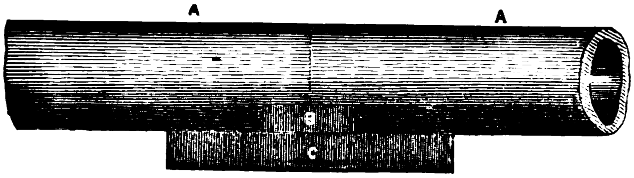
REGISTERED DESIGNS.

DRAIN-PIPE, CHAIR, AND SLEEPER.

Registered for the Grangemouth Coal Co., *Grangemouth, Falkirk.*

In this arrangement of drain-pipes, the obvious advantages are—the securing a solid foundation, simplicity of laying, the prevention of the

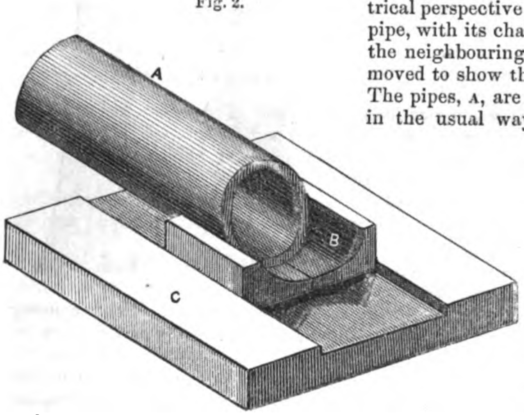
Fig. 1.



sinking at the joints, and the power of at once taking up any length of pipe without the slightest interference with the rest of the line.

Our engraving, fig. 1, is a side elevation of the joint, showing both pipes *in situ*. Fig. 2 is an isometrical perspective view of a single pipe, with its chair and sleeper—the neighbouring pipe being removed to show the joint clearly. The pipes, A, are laid end to end in the usual way, but the joint line is upon the centre of a chair, B, formed in two halves. This chair, again, rests upon a solid sleeper, C, having a sunk central platform of the width of the chair, the two pieces of which it holds securely together.

Fig. 2.

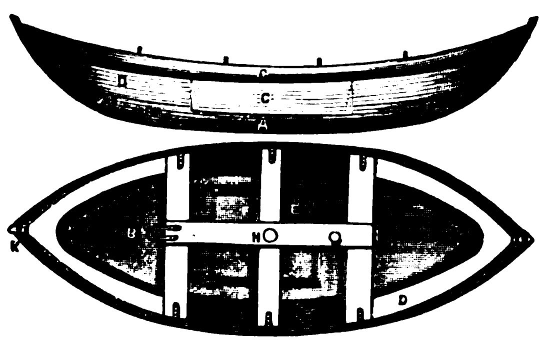


LIFE-BOAT.

Registered for Robert Anderson, Esq., *Westoe, South Shields.*

This is an improved life-boat, calculated for either beach service or for passenger vessels and steamers, 16 feet 6 inches long, 6 feet 6 inches broad, and 2 feet deep. Gunwale sheer, 16 inches; curve of keel, 7 inches; clinker built, entirely of wood, and copper-nailed; weighs

Fig. 1.

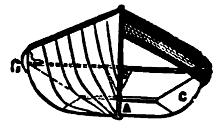


1-72d.

about 6 cwt. Fig. 1 is a longitudinal elevation; fig. 2, a plan; and fig. 3, midship section and end view.

She has an inner air-tight skin or ceiling, upon which all the air and water cases are fitted, and a well in the centre of her bottom, capable of containing 43 gallons of water, which can be filled with salt water as ballast, or with fresh water when leaving a sinking vessel, by means of valves which can be opened and shut as required. On each side, and at the ends of the well, are air-tight cases; and diagonal air-cases are also attached to each side, and air-tight seats round each end of the boat, capable of carrying dry provisions. She has sufficient buoyancy to empty herself, with a crew in and the well full, in two minutes, through two tubes in the bottom, and with four tubes she would empty herself in one minute. The water-ballast, 435 lbs., gives her great stiffness, so that she will not upset, and as she empties herself when filled, there is no danger of being swamped or sunk. The water-ballast has the advantage in beach service, that it is no weight to the boat until she is in the water, when the well fills itself. She has been severely tested in heavy broken water on the Head Sand, at the entrance of the Tyne, with perfect success; rows four or six oars, double bank'd; is fitted up with storm sails in case of need, and everything necessary for sea service.

Fig. 3.



1-72d.

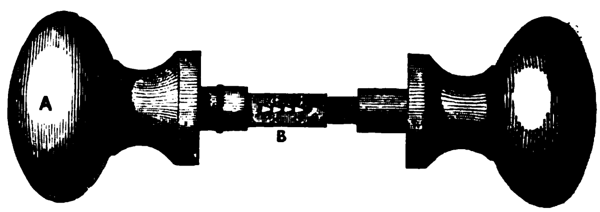
We append literal references to her chief details:—A, Water-tank; B, air-tight deck, the spaces below being divided into air-tight compartments; C, diagonal air-tight cases; D, air-tight seats, enclosing air-tight compartments for dry provisions; E, tubes with valves, for emptying the water out through the bottom; F, screw-valves to admit water into the tank, A; G, belt of cork; H, pump to draw water out of the tank; I, compass; K, inner skin, air-tight.

ADJUSTING LOCK-SPINDLE.

Registered for Mr. M. Cavanagh, *Queen's Road, Notting-Hill, London.*

Mr. Cavanagh's object in designing this lock-spindle, is explained in the title he has given to it. Fig. 1 is a half-size external elevation of the "lock-spindle" entire; and fig. 2 is a longitudinal section of the same corresponding. One handle, A, is fitted on a tubular spindle-shank, B; the other handle, C, being on the "adjusting spindle," which consists of

Fig. 1.



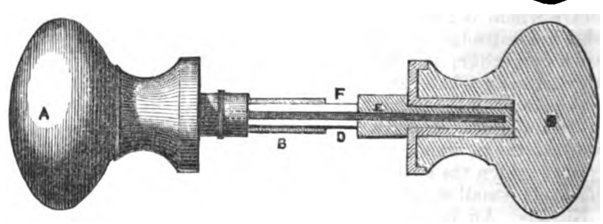


Fig. 1. 1/2

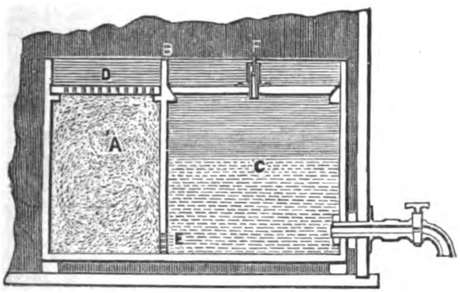
three parts, D, E, F; the outer portions, D and F, being each provided with a stud, G, arranged to take into holes or recesses, H. The formation of the spindle in three pieces—which constitutes the novelty of the design—so arranges it, that on the removal of the centre piece, E, the two outer ones collapse or fall together, and disengage the studs from their holes; after which, the spindle may be adjusted to any length, by inserting the studs into other holes. It is thus easily adapted to any thickness of door, a very important feature in house-fittings of this kind.

FILTERING APPARATUS.

Registered for Mr. J. Carter, *Delabole, near Camelford, Cornwall.*

Delabole is famed for its slate quarries, and Mr. Carter has taken advantage of the excellence and abundance of this useful material, in producing his simple and effective water-filter. Our engraving represents a vertical section of the filter as in action. It is placed in the bottom of a containing cistern, and is so arranged as to be self-supplying. The portion, A, contains the filtering medium, which is represented by the

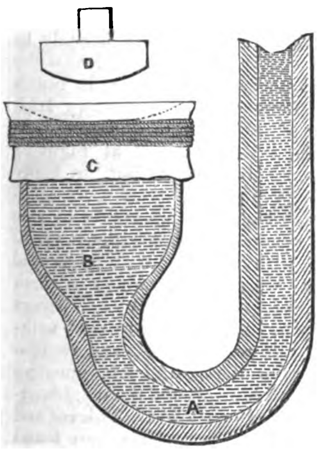
vertical division, B, from the pure-water chamber, C; the unfiltered water being allowed to enter upon the filtering medium by the perforated cover, D. When in action, the water, entering in this way, descends through the filtering medium, and passes into the pure-water chamber by perforations, E, in the bottom of the division, B. The pure-water division has a close-fitting cover, in which is a tube rising $1\frac{1}{2}$ inches above it, and having a small ball or clack valve opening upwards; and whatever air is contained in the division, C, above the pure water, is forced out through this valve as the supply is kept up from the filtering chamber. Then, whenever water is drawn off by the bottom tap, the air-valve, of course, closes, and a partial vacuum is thus formed above the water. This vacuum then causes the water column in the external cistern to act on the filtering medium, and again fill the pure-water chamber; and thus keep up a continued filtering action and supply of pure water.



BAROMETER TUBE.

Registered for MESSRS. CHADBURN, BROTHERS, *Sheffield.*

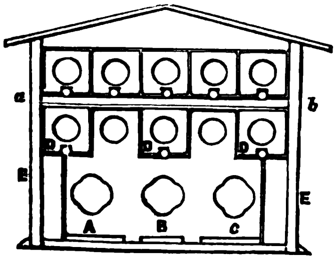
This design has reference to a novel configuration of barometer tube, for preventing the mercury from oscillating in the tube when the barometer is being moved from one place to another. The way in which this has generally been effected has been by fixing a straight tube into a cylindrical box, having an elastic bottom—this box holding the mercury; and, by means of an ascending button, the mercury is forced upwards, and made to fill the tube when the barometer is intended to be removed or packed for travelling. According to the present design, the glass tube, A, is bent round at the bottom, and its diameter is increased to form a mercury cup or cistern, B. This cup is covered with a piece of leather, or other flexible material, C; and when the barometer is to be packed for travelling, a button, D, is made to descend, and by pressing in the flexible material, it causes the mercury to mount and fill the vertical portion of the tube, A.



The advantages of this construction of barometer are, that it works more freely and accurately; the cup or cistern being glass—of one piece with the tube—it will not crack or swell with change of temperature or moisture, as is the case with wood cisterns; and the flexible cover being above the mercury, it cannot escape through it when the barometer is in use—should it not be perfectly tight—which it would do if the flexible material was at the bottom, as in those with the wood or other cisterns.

BEE-HIVE.

Registered for MR. W. KING, *Littlebury, Saffron-Walden.*



Our engraving represents a back elevation of Mr. King's bee-hive, with the door removed. The entrances on the front—here seen through—are at A, B, C, at the bottom, as usual; the two side ones, A, C, being for ventilation in warm weather. At D are drawers with glass windows, to admit of the removal of the honey, without involving the destruction of the bees. The frame, E, is made to take off, the middle also dividing along the horizontal line, *a b*. At the bottom of the drawers, D, is a long slot, or opening, also in the case in which the drawers are placed. The communication with the body of the hive is capable of being cut off by metal slides.

REVIEWS OF NEW BOOKS.

SANATORY MEASURES AT LIVERPOOL.

REPORTS TO THE HEALTH COMMITTEE OF THE BOROUGH OF LIVERPOOL. By the BOROUGH ENGINEER, INSPECTOR OF NUISANCES, and MEDICAL OFFICER OF HEALTH. Liverpool: 1851.

Liverpool on the Mersey, London on the Thames, Manchester on the Irwell, Edinburgh on the Forth, Glasgow on the Clyde, and Dublin on the Liffey! How many are the associations that crowd around these names! How they should stand out as instructors of the world!

About seven hundred years ago, Henry, the first of the Plantagenets, granted a charter to a town situate on the east bank of the Mersey—the then comparatively obscure place called "Lyrpul." This is the first time that Liverpool, the child of these distant ages, is found recorded in any document. A century after this, the number of houses was found to be 168, and that of those occupying them about 800. When George the Third began to reign, the number of houses had increased to 4,200, and that of inhabitants to 25,000. This number further increased as follows:—

1801.	1811.	1821.	1831.	1841.
79,722 ...	100,240 ...	131,801 ...	189,242 ...	286,026.

And now the total number of the inhabitants of the borough of Liverpool, exclusive of those in ships, steamers, and flats, is 369,273; and the number of houses is 59,342, or more than six inhabitants to a house, which is above the general average.

For this dense population (then, of course, slightly less) it appears that in 1849, 233,658 head of cattle of all kinds were slaughtered; and in 1850, 248,968. (2, 43.)*

About thirty years ago, Liverpool may be said to have bade farewell to the past of its history, and to have entered into training for its future, yet in prospect: for, in 1819, the only ancient building left standing, and which had served for ages as the palatial residence of the earls of Derby, was levelled with the ground.

With the increase of the population, which is probably unprecedented even in all history, and in the midst of circumstances which may thus be said to have been visibly flourishing, crept in an inattention and a carelessness as regarded the chief welfare of the place, until disease appeared as a monitor in a form of desolation which it was impossible not to heed. It appears that its behests have not only been listened to, but have been performed in such a manner as to enable this great second port of the world to hold itself up, to the home-tributaries towards its commercial significance, as an example worthy of all regard and imitation.

The first half of 1847 is memorable in the history of Liverpool; for by the end of June not less than 300,000 Irish had landed there, and of these from 60,000 to 80,000 had fairly settled themselves down. Every nook and corner of the then already overcrowded lodging-houses were occupied by these immigrants. In different parts of Liverpool, 50 or 60 of these destitute people were found in a house containing three or four small rooms, about 12 feet by 10, and, in more than one instance, upwards of 40 were found sleeping in a cellar. (3, 1.) All these people had fled from their country to avoid the famine caused by the failure of the potato crop (2, 3), and they brought with them the disease which had begun to desolate their country.

In the middle of April, there were 260 fever patients in hospital; in the middle of May, 800; and in the middle of June, 1,400; while nearly 4,000 in addition were under treatment at the patients' dwellings. (3, 6.) At the commencement, the fever affected almost exclusively the Irish living in crowded lodging-houses, but in the beginning of May the epidemic extended to other than the poorer classes of the inhabitants, and the wealthier classes were afterwards attacked. "The only localities which, up to the close of the second quarter of the year, resisted the fever poison, were Rodney Street and Abercromby wards—the best-conditioned districts of the town." (3, 8.) These, however, eventually succumbed to the epidemic influence. The usual weekly average of deaths in the parish had been about 160, but in the beginning of August the number had attained 537. (3, 9.) The general rate of mortality through-

* These figures refer to the Reports, viz., the first figure—1, 2, or 3—to the Report of the Borough Engineer, of the Inspector of Nuisances, or of the Medical Officer of Health; and the other figures to the page of their respective productions.

out this fatal year was unprecedented in the history of the town, amounting to more than twice the average. More than one-fourteenth part of the ordinary population of the *parish*, and more than one-sixteenth of that of the borough, perished. (3, 16.) No less than 1,200 widows were left to mourn the loss of their husbands, and nearly 4,000 children became unprotected orphans. (3, 19.) All will hope with Dr. Duncan, that this disastrous year may long remain without a parallel.

The fever gradually became less virulent until the end of May, 1848, when, after an existence of seventeen months, it was extinguished. This frightful visitation was immediately succeeded by the influenza, which, in two months, carried off 600 persons, heralding the more fearful scourge of epidemic cholera.

Leaving India, its apparent birth-place, in 1846, this new and unknown dread traversed Persia, Russia, and the north of Europe, by Berlin and Hamburgh, and made, as we have reason to remember, its appearance in Edinburgh on the 1st of October, 1848. In November it visited Glasgow and Dumfries, and raged with great severity. On the 10th of December, an Irish family arrived in Liverpool, by steamer, from Dumfries, where the disease was then at its height, and the first case of cholera in Liverpool was of one of the children of this family. The epidemic spread quickly. From week to week, with one exception, the mortality progressively increased up to the middle of August, 1849, when it attained the maximum of 572 deaths from cholera, and 856 from all causes, the latter number being about four times the weekly average! (3, 29.)

In June, finding the ravages of the epidemic in some localities uncontrolled by other precautions taken, Dr. Duncan (the medical officer of health for the borough) directed notices to be served on the owners to lime-wash the *exterior* of court-houses in the infected and threatened districts, in all cases where the courts were not open to the street throughout their entire width. One example suffices of the apparent benefit derived from this measure. In certain of the courts the weekly deaths from cholera were 14, but immediately after the lime-washing they were reduced to 3. (3, 42.)

The deaths in the borough, from all causes, during the cholera year, 1849, were 17,047, a number which, although 6,200 above the average of the previous five years—excluding the fever year of 1847—is still 4,082 below that fatal year of Irish immigration. (3, 48.)

The medical officer shows some curious results of his minute inquiries into the statistics of the cholera. Generally speaking, he says, a greater number of *new cases* were reported on Monday than on any other day of the week—a consequence, probably, of the excess in eating and drinking on the previous day. The greatest number of *deaths* occurred on Wednesday; many of the cases originating in the intemperance of Sunday and Monday proving fatal, probably, on that day. During twenty-two weeks of the epidemic period, the daily average of deaths on Wednesday was 57, and on the other days of the week rather more than 32. The minimum daily average—30⅓—occurred on a Sunday. (3, 37.)

It is a singular and significant fact, that during the ten days to which the visit of the cholera was confined to the borough gaol, it proved fatal to four prisoners only, out of a population of 800; the gaol, like all these establishments, being kept scrupulously clean, and situated in a tolerably open locality, although not one of those generally best conditioned. A medical assistant was, however, stationed in the gaol, and instructions given to the prisoners to apply for medicine on the first intimation of diarrhœa. (3, 33.) Dr. Duncan observes that it has been stated, that in all cases where a cholera epidemic is impending, diarrhœa is more than usually prevalent; but he informs us this certainly was not the case in Liverpool, and furnishes statistics to prove his position. The house-to-house visitation in cholera districts, as recommended by the General Board of Health, was adopted (as when the fever prevailed) with immense advantage at Liverpool, as at other places; and the principle of employing medical visitors, in preference to lay-visitation, was acted upon with equal benefit. (3, 45.) It is hoped that these visits of inspection may succeed, after a time, to use Dr. Duncan's words, in indoctrinating the humbler classes with sanatory principles; and in removing, to some extent, the apathy and ignorance which have hitherto prevailed. (3, 59.)

The two epidemics of fever and cholera afford some striking points of contrast. First, in their mode of propagation: fever spreading by contagion; cholera, dependent on atmospheric influences, appearing simultaneously in different localities;—the one, revelling amidst filth and overcrowding; the other, while evincing a predilection for such conditions, affording, at the same time, numerous exceptions to the rule, and attacking individuals and places not generally supposed obnoxious to the attacks of fever: the latter being thus, more decidedly than cholera, under the control of sanatory measures. With regard to age and sex also, there are striking points of difference in the more equal division of the fever mortality between the sexes, and the more even distribution of the cholera mortality over different periods of life. (3, 39.) It is noticeable, that no sooner had the Irish fever committed its ravages, than down came to the borough the "Nuisances Removal and Diseases Prevention Act" of 1848; and the cholera was in the midst of its devastation, when the "Amendment Act" of 1849 came to the relief of every well-wisher of populous neighbourhoods. Fortunately, the "Local Sanatory Act" had come into operation in January, 1847, at the very commencement of the Irish plague.

Mr. Thomas Fresh, the inspector of nuisances (to many of which the diseases mentioned above are greatly referrible), comes forward with his tale; and a pleasing one it is, when we see how many and what formidable ones he has already got rid of. An excellent plan of proceeding has been acted upon, with respect to the evils under his charge. All nuisances complained of are regularly inspected, not later than two days after complaint made; and forthwith a notice is delivered to the party causing such nuisance, to abate it, in such a way, and within such a period, as the law may require. On non-compliance with the requisition in the notice, other necessary proceedings are taken against the offending party. At the time the notice is issued, a note is also sent to the complainant, specifying what has been done; and requesting that, if any cause of complaint remains after the time given, a renewed application may be made. Subsequent official inspection of the seat of nuisance readily detects whether it has been effectually remedied or not. (2, 18.) Mr. Fresh's report concludes in an agreeable manner, by paying a doubtless well-deserved compliment to the officers employed under him; and by stating that such economy has been observed in fixing the amount of their remuneration, as to show that the entire salaries paid in his department do not amount to five-sixths of a farthing in the pound in the rates. (2, 53.)

Lodging-houses for the poor—not those "model lodging-houses" which are seen, with pleasure, rising like domestic palaces here and there, but those dens of shame and infamy which have been so fearfully exposed in the pages of Mr. Mayhew's "London Labour and the London Poor"—abound in Liverpool as in other large towns; but are gradually dwindling down in number, and those which still remain may happily be said to be a different class of thing altogether. We are told that the worst description of these houses were kept by low Irishmen, in courts and narrow streets; and were chiefly frequented by migratory Irish people, vagrants, and others. The floor of each room, in some of these houses, was covered with old bedsteads, which received at night as many human beings as could be crammed into them; but, in many places, even bedsteads were not to be found, and the lodgers were domiciled on wretched filthy pallets of straw, which were piled side by side on the floors; and as the rooms were generally almost without ventilation, when they thus became filled with inmates, they presented scenes of wretchedness which are almost indescribable. Many of them have frequently been seen crowded, in the night-time, with human beings lying side by side on the floors as closely as they could be packed, without any distinction of either age or sex; and as cleanliness and ventilation were seldom thought of by the keepers, the natural consequences frequently followed—fever and infection spreading around the neighbourhood, from each of these houses, as a centre of pestilence. Thieves and vagabonds of all descriptions, and criminals of every shade, here found their homeless-home. And they chose their frightful hiding-places wisely, for the fear of contagion might well lessen the heat of pursuit, which otherwise might have given earlier up to justice those whom disease, in a few hours, secured as among its ordinary victims. Fortunately this state of things claimed and received early attention; and the establishment of a daily and nightly inspection of lodging-houses, by the nuisance officers and the police, has had the effect of materially checking these tendencies.

One particular fact may be mentioned:—In a certain number of lodging-houses, whose history Dr. Duncan was enabled to trace, about 150 cases of fever occurred annually, previous to registration (excluding such years as 1847). During the cholera year, the cases in these houses amounted to 98. In estimating the value of this fact, the medical officer observes, that it must be remembered that the total cases of fever in the town, in the year when 150 cases occurred in the lodging-houses were only about 5,000; while, in 1847, there were not less than 10,000 cases of cholera in the town, and only 901 in the same houses—registered and under sanatory inspection. So that, in fact, the cholera in the houses *after* registration, was only in the proportion of about one to three, as compared with fever *before* registration. (3, 66.)

Nihil, simul, inventum est et perfectum, is, we believe, a maxim among our legal friends, who quote it in support of precedents. But it is universally true, and necessarily so. Why, then, should we regard with so much apparent indignation and ridicule, the efforts of legislators in these

times? It is easily excused, that Liverpool sanatory acts, as well as any other acts (but sanatory acts above all others), do not, at first, contain all the provisions that a course of practical operations under them alone can suggest. This falling-short is occasioned by such acts being framed, "when the subject was not so fully understood as at present," as Mr. Fresh very properly expresses himself. This gentleman sets about doing, at once, the very next best thing which can be done, and suggests numerous improvements in those matters coming under his immediate supervision. With regard to these *lodging-houses*, we agree with him in judging that it would be a great improvement if powers could be obtained to fix the number of persons who could be accommodated, with a due regard to health, in each inferior lodging-house, without any distinction as to whether they were weekly or nightly lodgers, or the keeper's family. The Health Committee, he also suggests, should also have power to refuse to license, as a lodging-house, any house or premises which they might deem inadequate to the purpose; and that it would likewise be desirable, in order to prevent immorality, to obtain powers, if possible, to provide for a proper classification of the sexes in licensed lodging-houses. (2, 35.) The liberty of the subject *must* yield a little to substantial general benefits of this kind.

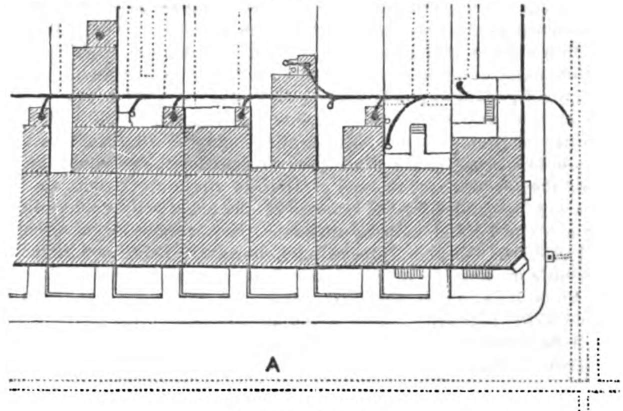
The poor intending emigrant was often, and is now, to a great extent, compelled to take up his temporary abode in these lodging-houses; the very best, however, of which, are being superseded by what have been called "Emigrants' Homes," and in which all arrangements will be made for the decent comfort, at a minimum of expense, to those resorting to them. (2, 37.) These will thus be free from those fears which the knowledge of facts must bring upon them, as regards introducing their children to these lodging-houses, where many instances have been known, of poor orphan and destitute girls, who originally gained a scanty and precarious livelihood, either by hawking small articles, charing, or by begging about the streets by day, and who took refuge in these dens by night, having ultimately turned out prostitutes; which consequences could, but too frequently, be traced to the natural barriers of decency and delicacy having been first broken down and destroyed by the contamination of these places, and which exposure ultimately led to their final destruction. (2, 35.) Government has very wisely followed public opinion in this matter, and the labouring classes' "Lodging-houses Act, 1851," will be instrumental in producing a better order of things.

The labour of the inspector, before commencing his "cellar operations," seems, in prospect, to have been formidable enough; for the separate occupation of cellars as dwelling-places, has, in Liverpool, been carried to a greater extent, than in almost any other town of the United Kingdom. We may imagine what this must have been, when we are told that the number of cellar inmates, simply removed from cellars, in the borough of Liverpool, within three years, has amounted to 30,009. (2, 27.) "When these *cellars* were examined in the early part of 1847, 5,871 were found in a state which required drainage and cleansing—in fact, in a filthy and unwholesome condition. The improvement which a little care and attention have effected is remarkable. The numbers of notices to the owners, or occupiers, to remove stagnant water from these places, were, in 1848, 840; in 1849, 405; in 1850, 150; and during the first five months of 1851, only 10 of such notices were required to be issued, although there is a cellar staff of officers employed in going round the unhealthy districts daily, making house to house visitations, and whose duty it is to report all such cases met with by them." (2, 50.) This result affords full proof of the benefit attending continued inspection by trained officials, and which may readily be extended to many other matters.

The cholera came only after 5,000 cellars had been cleared of their inmates (3, 101), or its ravages would have been greatly more disastrous. In 1847, the *cellar population* formed about 12 per cent. of the entire population of one district. At the commencement of 1851, it amounted to less than 2 per cent. In connection with this fact, it is significant of the sanatory value of removing the cellar population, that while the disease, which raged previously to the clearance of the cellars, carried off upwards of 500 of the inhabitants of the district—that which prevailed after the cellar population had been reduced to one-sixth of its former amount, caused only 94 deaths in the same district; the total number of victims throughout the *borough*, from each epidemic, being nearly alike. (3, 101.)

Particular attention has likewise been paid to *house-draining*; and a peculiar system of such drainage has been, wherever practicable, pursued. Mr. Newlands, the borough engineer, enters upon a comparison of the plan of a block of houses, taken from the Government Blue Book, and given there as an exemplar of the best mode of draining (represented in fig. 1), with the plan of a block of Liverpool houses, with the mode of draining that has all along been followed there (shown in fig. 2). Here A, in each case, is the main sewer, and B, the front street, C, the back passage.

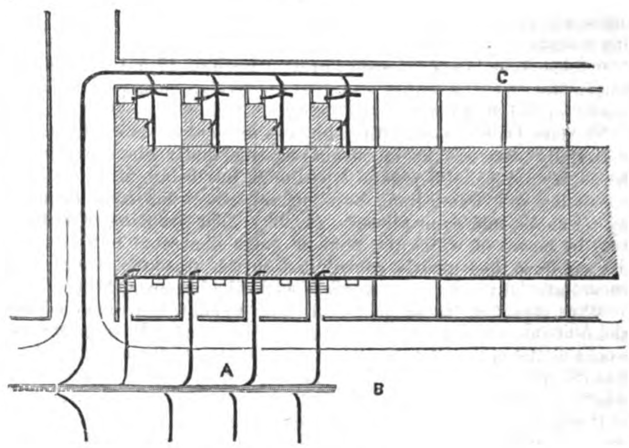
Fig. 1.



1⅛ inch = 50 feet.

At Liverpool, the rule has been steadily adhered to, that every house shall have its own drain. The importance of this, we are informed, has been repeatedly shown. "A party builds a block of houses abutting on a street which is sewered; but to lessen the expense of draining them,

Fig. 2.



1⅛ inch = 50 feet.

he makes a drain along the front of the property, say along the areas, into which he leads a branch from every house. After a time, the property changes hands, and each house, we shall suppose, acquires a different owner. By mismanagement, or neglect, the front drain is stopped up, or it becomes injured by alterations on the premises; but the exact extent and situation of the damage is not known. The occupants of all the houses now begin to suffer from the stoppage of the drain; but the owners will not combine to remedy the evil, and, at last, recourse must be had to the Health Committee's officers, who take the necessary precautions, under the 46th clause of the sanatory act. In the meanwhile, however, the occupants of the houses are injured in their health, and interrupted in their household labours, and are forced to vacate the premises." Of the two plans, the engineer goes on to say,—it will be seen that the difference between them is broadly this: that whereas, in the Government plan, any accidental stoppage occurring in the pipe could not be removed without trespass on private property; in the Liverpool plan, the main tubular sewer, or drain, into which the house branches are inserted, is in the public passage, and access can be obtained to it without interference with the private houses, their gardens, or yards. Mr. Newlands goes into further details in favour of the Liverpool plan, to which we must merely refer. It appears that, from May, 1847, to April last, the number of houses which have been drained in the borough amounts to 10,504. (1, 50.) There being no clause in the sanatory act, under which a party tunnelling under a street without permission can be dealt with, Mr. Newlands suggests that an enactment should be

obtained, that all drainage work whatever shall be done by a contractor, or contractors, appointed by the Health Committee. (1, 34.)

The emptying of middens, or cess-pools, forms another mode of applying beneficially the powers given by the sanatory act. These receptacles, with their companion ashpits, even in a locality carefully supervised, are subjects requiring the most zealous attention, when but a very little observation makes us acquainted with the conditions under which they exist in the lower neighbourhoods. And when we are told, that prior to the introduction of guano as a manure into this country, the nightmen in Liverpool, not only emptied many of the middens free of expense, but occasionally gave an equivalent for the privilege of doing so, and that, from about the end of 1846 to the present time, exorbitant prices are demanded for the removal of the night soil, we may imagine what a hydra-headed monster-nuisance these things might become in bad localities. Vigilant proceedings, however, being conducted in a systematic manner by a responsible force, the evil has been reduced; and when it is stated, that from the 4th of April, 1847, to the 31st of March, 1851, 203,373 middens alone have been emptied in the borough, it will be acknowledged how much more efficient are public officers for the purpose, than can be the plan of leaving such things to private individuals.

In the matter of sewers, with which these things are more particularly connected, much has been done. The course adopted for their construction, is to select the parties who tender for the work; and this has been found to be "attended with the best results, as the committee have the guarantee of character for the proper fulfilment of the contract, a security," in the estimation of the borough engineer, and in our opinion, "far better than the guarantee of a bondman." (1, 13.)

Such sewers have been constructed as, in the opinion of the medical officer of health, would most effectually contribute to remove one principal cause, at least, of disease, and the results have abundantly justified the opinion thus acted on.

"Since June, 1847, the very great length of 17 miles of sewer has been constructed, a length equal to about one-tenth part of the total length of existing roads in the borough." (1, 4.)

The formation of new gullies, and the reconstruction of old ones, have materially assisted the important reforms under the direction of the borough engineer. Separate depositories are being formed for refuse, consisting of "waste lime, building rubbish, brick bats, slates, soot, oyster shells, and even ashes." (1, 22.) The trapping of the gullies, too, by means of which the noxious gases generated by the sewerage are confined, has greatly contributed to the reasonable hope that all must have, of the ultimate result of such-like improvements.

With regard to these gases, in order to show the extended tone of thought that these matters are taking, Mr. Newlands suggests, as the means of doing so exist, "trying the experiment of ventilating the chief lines of the sewers by a large chimney, and of consuming in it the gas." (1, 23.) As it is somewhat curious, we give his own words on the subject:—"At the Crown Street station of the London and North Western Railway, there is a disused chimney of great height. It is possible, at a very small cost, to connect with this chimney the line of sewer to Beacon's gutter, which is three miles long, the Parliament Street sewer, and the Falkner and Myrtle Street sewers, all having an immense number of tributaries. The base of the chimney is situated at the height of 184 feet above the Old Dock sill, which is above the level of all the sewers in the parish of Liverpool. The experiment," he goes on to say, "will, I believe, be decisive of the question of the utility of ventilation, and of consuming the gases." (1, 23.)

The economic use of sewage manure, which has mainly been brought into notice by the company established for the purpose in the metropolis, is treated of in the engineer's report, and he inclines to an opinion formerly expressed by him, that such manure can be turned to profitable account only when used in a liquid state for irrigating grass lands by hose and jet distribution; and he instances, as an example of the benefit of its use in this form, the waste lands near Edinburgh, which have, by these means, been rendered so wonderfully productive. The London Sewage Manure Company intended to carry on the manufacture of a dry portable manure from the liquid sewage by precipitation under chemical processes; but Mr. Newlands, who has visited the works, considers that experiments on a large scale are wanting to test the process, and such experiments, notwithstanding the operations of the company, still appear to be wanting. Should, however, the commercial value of this dry manure be such as to establish it in the market, the process would be at once the most economical, the most safe, and the most profitable way of turning to account the fertilising property of the sewage. (1, 58.)

Broken ground, with stagnant pools of water upon it, was another evil greatly tending to malaria and disease. By active measures taken under the sanatory act, the majority of these have been drained, or the water removed.

Paving is another item in the engineer's report, and an important one, too, as regards expense, when it is shown that there are in Liverpool more than three million and a half of superficial yards of carriage ways, channels, and footways, besides more than a quarter of a million of square yards occupied by courts and passages. Some idea of the significance of these sounding numbers may be gained, when it is stated that, on the 1st of February last, when the figures were ascertained, the total length of carriage ways is 174 miles, and that of the courts and passages 69 miles. (1, 63.)

The practice of paving by contract is being superseded at Liverpool, a system having lately been acted upon by the committee of contracting with their own workmen for the labour, or, in other words, paying them by measurement, whereby all the benefits derived from letting the work to a contractor are secured, and many other advantages obtained, beside the actual cost of the work done being lower than contract work. (1, 76.)

For footpaths, Caithness flags have been largely introduced, as a substitute for the flags of the north of Lancashire. But a flagstone of the same nature has, it appears, been recently introduced from Ireland, which, if found to be as durable, as the experiment of juxtaposition in considerable thoroughfares is being tried, will, it is supposed, effect a very large saving in the expenditure. The use of granite for curbstone, in place of the sandstone of Yorkshire and Lancashire, has been largely extended, and with great advantage, especially in narrow streets, where the constant grinding of the wheels soon disintegrates the soft stone (1, 74), and street wheel-channels are strongly recommended.

Durable materials used in the best manner are shown to be, in the end, the most economical for paving purposes. In all streets subjected to heavy traffic, the engineer suggests that boulder paving and macadam should gradually be superseded by a pavement of square sets.

The following table, showing the maximum and minimum cost out of nine examples which Mr. Newlands gives in each, will show at once the economical advantage of the set paving, when the maintenance alone of the street is regarded:—

MACADAM PAVING.

Streets.	Contents in superficial yards.	1848. Cost per annum.	1848. Cost per yard.	1849. Cost per annum.	1849. Cost per yard.	1850. Cost per annum.	1850. Cost per yard.	Average cost p. yd. for 3 years.
		£ s. d.	d.	£ s. d.	d.	£ s. d.	d.	d.
Renshaw...	1,085	89 11 0	19·8083	75 10 10	16·7097	83 4 0	18·4036	18·3072
St. Anne...	3,528	48 19 2	3·3305	69 11 11	4·7344	49 1 10	3·3396	3·8015

BOULDER PAVING.

Streets.	Contents in superficial yards.	1848. Cost per annum.	1848. Cost per yard.	1849. Cost per annum.	1849. Cost per yard.	1850. Cost per annum.	1850. Cost per yard.	Average cost p. yd. for 3 years.
Simpson...	1,675	23 8 9	3·3582	2 5 10	·3283	15 3 9	2·1761	1·9542
Soho.........	3,273	3 1 1	·2236	4 6 0	·3153	......	......	·1796

SET PAVING.

Streets.	Contents in superficial yards.	1848. Cost per annum.	1848. Cost per yard.	1849. Cost per annum.	1849. Cost per yard.	1850. Cost per annum.	1850. Cost per yard.	Average cost p. yd. for 3 years.
Dale.........	8,599	......	......	36 6 6	1·0138	4 13 7	·1305	·3814
Leeds.......	6,775	......	......	2 16 4	·0998	2 6 6	·0823	·0607

Other statistical tables inserted, prove that the cost of maintaining macadam is 56 times as great as the cost of maintaining square sets under similar circumstances, or, in other words, macadam costs 1s. 6d., and square sets about three-tenths of a penny. (1, 66.)

These amounts do not, however, include the first cost, the interest upon which should be taken into account. If this is assumed at 4 per cent., the comparison is made to stand thus:—

	First cost per yard.	Total at 4 per cent.	Maintenance.	Total.
Square sets,.............	4*s*. 6*d*.	2·16*d*.	·28*d*.	2·44*d*.
Boulders, ...	1*s*. 8*d*.	·8*d*.	6·8*d*.	7·6*d*.
Macadam,.................	1*s*. 8*d*.	·8*d*.	·16*d*.	16·8*d*.

And it is seen that square set paving forms absolutely the cheapest surface where the traffic is heavy; and when the further advantages of safety, freedom from dust, and the less cost of sweeping and watering, are added, its economy is very clearly evidenced. (1, 66.)

Mr. Newlands goes on to show, that, by the adoption of this system, the streets within the parish of Liverpool, with certain exceptions noticed by him, may be paved in the best manner, and that the paving rates, nevertheless, will not exceed sixpence in the pound. (1, 71.)

There are in round numbers 282,000,000 of superficial yards of streets which were kept clean by *sweeping* during 1850. The cost of doing this amounted to £10,002. 2s. 10d., being about ·036 of a farthing per square yard per annum, including labour, implements, cartage of the sweepings,

and superintendence. The engineer gives a table, strikingly showing the fallacy of averages in this matter, and how great loss might accrue by persons accepting contracts under them. (1, 87.)

In that desirable matter, *street watering*, by substituting improved distributory apparatus in some of the carts, as old pipes wore out, a larger area was watered during 1850 at a less cost than in former years. The new apparatus having been applied to nearly all the carts, Mr. Newlands hopes to be able forthwith to dispense with nearly one-third of the number formerly used, or to extend the watering to places which, hitherto, have been without that benefit. (1, 88.)

Water and gas trenches are sore subjects to the pavior, who, it often happens, has just seen his work completed when it is disrupted for purposes connected with one or the other. In his report of 1848, Mr. Newlands had suggested a plan of side trenches, but this does not seem to have been acted upon, and the problem it involves remains in Liverpool, as elsewhere, as yet, unsolved.

The number of courts and passages washed in Liverpool during the season of 1850 was, altogether, 13,458, at a cost of one-sixth of a penny per superficial yard. (1, 88.)

With regard to hoards and scaffolds, the engineer strongly recommends the adoption of a system of licensing, as it has been found very beneficial in London in preventing such things remaining as obstructions and nuisances longer than absolutely necessary. And an apparently carefully prepared set of rules, and a scale of fees, are added, as proposals to be acted upon in this respect.

Many new urinals have also been constructed of cast-iron and corrugated iron, and no less than 42 more eligible sites are pointed out for these conveniences.

The Health Committee of Liverpool have originated a code of improved slaughter-house regulations, now incorporated with their bye-laws, which have been the means of effectually striking at the root of the grievous nuisances such places formerly caused. That clause, in particular, is an incalculable improvement, which provides for the removal of the refuse and garbage in tight boxes every twenty-four hours, instead of having it thrown, as formerly, into middens upon the premises, where it decomposed, to the obvious prejudice of all sanatory conditions. It appears that an Abattoir Company has been formed (2, 39) for the purpose of doing away with slaughter-houses in the heart of the borough, which will doubtless be effected at no distant date, when the returns show that the number of heads of cattle, of all kinds, slaughtered in the abattoir in 1849, nearly doubled that of animals killed in private slaughter-houses; and the returns for 1850 are still more favourable. (2, 43.)

The new system, now being universally adopted, of baths and wash-houses, is doing much also in this great borough to induce, by personal habit and custom, a desire for encouraging the labours of those whose attention is directed to the more general, but not more obvious means of health.

The *consumption* or *prevention of smoke* has here, where floating steamers abound, received almost more attention than in commercial places like our own town, where giant chimneys and their outbursts are near or next-door neighbours. But difficulty of treatment is a matter which appears to affect operations everywhere on this subject. However, we have an assurance and hope, that where difficulty only lies in the way, it will be sooner or later overcome. Little seems as yet done, but a sharp look-out is kept as to the owners of all furnaces in the borough, and of all steam-boats plying in the river Mersey, which are comprehended in the clause of the sanatory act relating to the consumption of smoke. (2, 46.)

Mr. Fresh touches on cemeteries, but in a few words only, as he appears to rely upon the question of intramural interment being now undergoing the attentive consideration of Government. He tells us, however, that the parish has lately provided an extensive cemetery, containing about twenty-five acres of ground, about two miles beyond the precincts of the borough, and that this accommodation is likely to be soon brought into very general use. (2, 48.)

A summary of the duties of each of the three officers under the sanatory act, and of the officials under him, is appended to the respective reports, suggesting many topics of interest and importance, and copious indexes are usefully attached to each of the reports.

The inspector of nuisances informs us that a peculiar system of taking the statistics daily has been originated in his department, by means of which full information can at any time be given to the Health Committee (or to any Government inspector who may visit the town), on the exact state of the working of every branch of the department. (2, 52.)

We have seen at what a small cost, under intelligent and careful management, sanatory measures can be adopted. We trust the example and encouragement thus offered by Liverpool to other towns to "go and do likewise," will be taken. We should indeed be glad to see even every little village benefiting by the incontrovertible statements made in these reports.

The river situation of all the places named at the outset of this article, precludes all excuse which may be attempted for remissness in adopting every sanatory precaution which the present state of knowledge offers to us. From a table, given by Dr. Duncan, of the aggregate deaths (in wards) in three years, 1848-50, from zymotic diseases—fever, consumption, convulsions, diseases of the stomach, and other organs of digestion—it is demonstrated that *the mortality is highest in the worst-conditioned wards in the town.* (3, 54.) The benefit resulting from the sanatory measures taken and still acted upon in this new and great borough, is demonstrated by the fact, that, in 1850, the general mortality was lower than in any year of whose mortality we have any authentic record. The total deaths were 10,123, being 6,923 less than in the previous year, and 3,026 less than the average mortality of the preceding seven years. Deducting the deaths from cholera, the decrease, as compared with the previous year, was 1,725. (3, 50.)

Dr. Duncan confirms these statements by another fact. He names a street, formerly one of the most unhealthy in Liverpool—most of the cellars containing stagnant water, and all the middens being undrained. In 1847, about 200 deaths from fever occurred in the street, in addition to about 250 more from other causes. In the beginning of 1849, it was sewered; and during the epidemic of that year, the deaths from cholera were only 36; the total deaths in the borough from cholera falling little short of those from fever in 1847. (3, 69.)

The result of all the movements that have thus been made, shows how, by the institution of committees and intelligent and responsible officers, and the necessarily increased division of labour, the most hopeful prospects are brought about—how filth may be changed into cleanliness, and disease into health.

We have entered at unusual length on the subject, as it is, especially at present, of such universal significance and interest; and cannot conclude without noticing, with pleasure, the good feeling existing among the officers whose reports have thus been passed under review. This has, no doubt, greatly induced to the advantage of each of them in their several positions; and, of course, to the public at large. Might not—we only throw this out as a hint—might not periodical meetings of such officers, from half a dozen or more of the principal places in the United Kingdom, be arranged, by which, it is probable, their efficiency would be considerably increased?

The General Bearing of the Great Exhibition on the Progress of Art and Science. By William Whewell, D.D., F.R.S., Master of Trinity College, Cambridge. London: David Bogue. Pp. 34.

When one of the few, whose reputation is not confined to European celebrity, steps from his professorial chair, and mingles with the herd of men for the purpose of sharing with them, for a time, the exercise of common faculties—the eye may well turn upon him with no small portion of that interest which, but for his presence, would be exclusively attached to other things. In proportion to his own attainments, the yet secret impression made upon him attracts around it an interest of deeper significance, which is increased to its maximum when a man of Dr. Whewell's calibre barely proposes to make such impression public. At science and philosophy of all kinds—from the highest flight made in morals, through all the intricacies of political economy, and every department of the physico-mathematical sciences, down to the simplest teaching in mechanics—has he long laboured, and laboured not in vain. Wherever science is known, Whewell's name is known; and his "History of the Inductive Sciences," and their "Philosophy," bid fair to be hand-books on those subjects for years to come, both to early and later manhood; and yet we find him, as is intimated in this last work, a player with the merest toys of scientific literature. It is not therefore to be wondered at, that his present discourse should command, and, in some degree, reward attention.

The council of the Society of Arts of London did wisely in instituting a course of lectures on the results of the Exhibition. They have done wisely in appointing some of our eminent men to prepare and publicly deliver these lectures. They could not have acted more wisely, than by selecting, as they did, the distinguished "Master of Trinity" to deliver the Inaugural Lecture, of which we give the title above.

Let us see what "represents the views" of this "unconnected spectator of the great spectacle," as the lecturer calls himself, on the general bearing of the Great Exhibition on the progress of art and science. The first conclusion at which he arrives, is on the natural character of man as "an artificer, an artisan, an artist." Referring to the Exhibition, he says—

"We have had there collected, examples of the food and clothing, and other works of art, of nations in every stage of the progress of art. From Tahiti, so long in the eyes of Englishmen the type of gentle but uncultured life, Queen Pomare sends mats and cloth, head-dresses and female gear, which the native art of her women fabricates from their indigenous plants. From Labuan, the last specimen of savage life with which this country has become connected, we have also clothes and armour, weapons and musical instruments. From all the wide domains which lie within or around our Indian empire, we have rich and various contributions; from Sincapore and Ceylon, Celebes and Java, Mengatal and Palembang. The ruder and more primitive of these regions send us their native food and clothing, their fishing-nets and baskets; but art soon goes beyond these first essays. From Sumatra we have the loom and the plough, lacquered work and silken wares; and as we proceed from these outside regions to that central and ancient India, so long the field of a peculiar form of civilization, we have endless and innumerable treasures of skill and ingenuity, of magnificence and beauty. And yet we perceive that, in advancing from these to the productions of our own form of civilization, which has, even in that country, shown its greater power, we advance also to a more skilful, powerful, comprehensive, and progressive form of art. And looking at the whole of this spectacle of the arts of life, in all their successive stages, there is one train of reflection which cannot fail, I think, to strike us; namely, this:—In the first place, that man is by nature, and universally, an artificer, an artisan, an artist."

Undoubtedly; and to confirm this important truth, an individual has only to analyse closely the actions of his *own every-day*. If he do not, by this means, find that he is the artist, the artisan, the artificer; why, all the teaching in the world, and out of the world, will not enable him to learn it.

Dr. Whewell then touches upon progression in man's artistic labours; and boldly weighs some familiar ideas thus:—

"The gorgeous East showers its barbaric pearl and gold into its magnificent textures. But is there really anything *barbaric* in the skill and taste which they display? Does the Oriental prince or monarch, even if he confine his magnificence to native manufactures, present himself to the eyes of his slaves in a less splendid or less elegant attire, than the nobles and the sovereigns of this our Western world, more highly civilized as we nevertheless deem it? Few persons, I think, would answer in the affirmative. The silks and shawls, the embroidery and jewellery, the moulding and carving, which those countries can produce, and which decorate their palaces and their dwellers in palaces, are even now such as we cannot excel. *Oriental* magnificence is still a proverbial mode of describing a degree of splendour and artistical richness which is not found among ourselves."

He proceeds to ask the question—"What, then, shall we say of ourselves? wherein is our superiority?" Hesitating, doubting, he gives expression to his doubt in a general exclamation—"Surely that mighty thought of a PROGRESS in the life of nations is not an empty dream!" He again appears mentally to gaze upon Eastern and Western civilization, and puts the following question and reply:—

"What is the leading and characteristic difference between them and us, as to this matter? What is the broad and predominant distinction between the arts of nations rich, but in a condition of nearly stationary civilization, like Oriental nations, and nations which have felt the full influence of progress like ourselves? If I am not mistaken, the difference may be briefly expressed thus:—That in those countries the arts are mainly exercised to gratify the tastes of the few; with us, to supply the wants of the many."

"This, therefore, is the meaning of the vast and astonishing prevalence of machine-work in this country:—that the machine with its million fingers works for millions of purchasers, while in remote countries, where magnificence and savagery stand side by side, tens of thousands work for one. There Art labours for the rich alone; here she works for the poor no less."

Now, it must be confessed, that an appreciable truth is discoverable in what is thus advanced; but some misgiving, which we cannot control, tells us, with a higher authority than that of the distinguished lecturer, that what he states is but as a simple case under a rule. To whatever extent it may delight the feelings, it does not completely satisfy the mind, which is always hunting after rule, and which, in itself, is but a portion of order. At some future time we may possibly endeavour to dive more deeply, and we hope not uselessly or inappropriately, into what is thus flimsily skimmed over, or artfully avoided. A distinguished and favourable opportunity was given to the Master of Trinity to enter more on the subject, and to suggest, at least, some form of order which he might have selected as the most agreeable, with all facts known to him. He has, however, postponed for a time, or for ever, an investigation for which he of all men—as combining the systematic moralist with the physician—is the most competent; and, of course, we have to do, not with what he ought to have done, but with what, in the instance before us, he has done. We turn from the subject with reluctance, because his former publications made us almost certain that he was near the discovery of some, as yet unacknowledged, but immensely important, general truth, which might well have found voice on this occasion.

We do not remember to have seen the following facts before generalized. They become very interesting when the subject of *scientific classification* is considered. The difficulty of proper classification appears to be commensurate with its importance, and we are glad to find that, in the great show, now over, we have improved upon those who preceded us.

"We have experimental evidence of the difficulty of classifying a great collection of the products of art and industry, in the attempts which were made to perform that task on the occasions of the French *Expositions* in 1806, in 1819, in 1827, in 1834, and in 1844. On the first occasion, the distribution adopted was entirely geographical; on the second, it was what was called an entirely material or natural system, dividing the arts into thirty-nine heads, the consequence of which is said to have been great confusion. In 1827, a purely scientific arrangement was attempted, into five great divisions, namely, *chemical, mechanical, physical, economical*, and *miscellaneous arts*. But this was deemed too artificial and abstract; and in 1834, M. Dupin made the division depend on the relation of the arts to man, as being *alimentary, sanatory, vestiary, domiciliary, locomotive, sensitive, intellectual, preparative, social*. This analysis was also adhered to in 1839. In 1844, an attempt was made to unite some features of the previous systems, and the objects were classified as *woven, mineral, mechanical, mathematical, chemical, fine arts, ceramic*, and *miscellaneous*; which was still complained of as confused, but which was, on the whole, retained in 1849."

"In the arrangement of the Great Exhibition of 1851, by a just and happy thought, a division was adopted of the objects to be exhibited into four great *Sections*, to which other *Classes*, afterwards established, were to be subordinate; these sections being *raw materials, machinery, manufactured goods, and the works of the fine arts*. The effect of this grand division was highly beneficial, for within each of these sections, classes could be formed far more homogeneous than was possible while these sections were all thrown into one mass: when, for instance, the cotton-tree, the loom, and the muslin, stood side by side, as belonging to the *vestiary* art; or when woven and dyed goods were far removed, as being examples, the former of *mechanical*, the latter of *chemical* processes. Suitable gradation is the *felicity* of the classifying art, and so it was found to be in this instance."

The several classes in the Exhibition were distributed into sub-classes, and these, as our readers know, into heads, by numbers. With regard to these subdivisions, Dr. Whewell tells us the pleasing fact, that great aid in the task of their arrangement was found in the Trades' Directories of the large manufacturing towns, showing how philosophy may learn from practical experience.

General truth is dependent upon correct classification. Such classification alone makes general propositions possible; "a maxim which," the lecturer remarks, "we may safely regard as well grounded, since it has been delivered independently, by two persons, no less different from one another than Cuvier and Jeremy Bentham." Much, unquestionably, has been done in rendering our classifications less imperfect; but many more improvements are reserved for that master-mind who shall, at some time or another, arise in the world of facts, and who, not contented with patching up here and there, shall review the whole, and marshal them as a new orderly alphabet into all literature.

The subject was a tempting one, and we have been drawn into it more at large than was our intention. One line may often do as a review of a many-volumed work, and upon a few pages a many-volumed review might be written. In conclusion, we shall apologise neither to the author nor to our readers for quoting the following eloquent peroration to this first discourse of a series which is likely to command so much attention:—

"In speculating concerning universities, we are accustomed to think that, without underrating the effect of lectures and tasks, of professors and teachers, still that among the most precious results of such institutions is the effect produced upon those who resort thither, by their intercourse with, and influence upon, each other. We know that by such intercourse there is generated a community of view, a mutual respect, and a general sympathy, with regard to the elements of a liberal education, and the business of national, social, and individual life, which clings to men ever after, and tends to raise all to the level of the best. And some such effect as this would, we may suppose, be produced upon the students of the useful and the beautiful arts, by their resort to any university in common. To *any* university, I have said; but to what a university have they been resorting during the past term? To a university of which the colleges are all the great workshops and workyards, the schools and societies of arts, manufactures, and commerce, of mining and building, of inventing and executing in every land—colleges in which great chemists, great mechanists, great naturalists, great inventors, are already working, in a professional manner, to aid and develop all that capital, skill, and enterprise can do. Coming from such colleges to the central university, may we not well look upon it as a great epoch in the life of the material arts, that they have thus begun their university career—that they have had the advantage of such academical arrangements as there have been found, and still more, as I have said, that they have had the greater advantage of intercourse with each other? May we not expect, that from this time the eminent producers and manufacturers, artisans and artists, in every department of art, and in every land, will entertain for each other an increased share of regard and good-will, of sympathy in the great objects which man's office as producer and manufacturer, artisan and artist, places before him—of respect for each other's characters, and for the common opinion of their body, all increased by their being able to say, "We were students together at the Great University in 1851?"

THE INDUSTRIAL EXHIBITION. Reprinted from the "Westminster and Foreign Quarterly Review," for July, 1851. 8vo, pp. 51.

An article deserving a longer than an ephemeral existence. The writer, filled with enthusiasm, and, what is equally good, an evident practical experience in many of the multitude of subjects claiming his attention, leads one on, even in this thrice-told tale, from page to page, offering a suggestion here, and throwing out a useful hint there, until

we feel our interest exhausted only with the conclusion. He signs himself "Helix," but we assure our readers there is nothing snail-like nor worm-like in him. Here is an anecdote he relates of the Great Fair:—

"It is a pleasing spectacle to look back upon how this building grew. A man whose whole life had been given to the care of plants, and buildings for their protection, made up his mind that a greenhouse in general, and his greenhouse in particular, was the thing required for space, cover, and light. And so he drew up his statistics. But it was essential that men, and money, and material, and skill, and enterprise, should be found to make his imagination a practical fact. Fox and Henderson were those men. As the modern phrase has it, they were "the masters of the situation." Their sagacity decided at once that it was correct in principle, and they agreed to his proposition of tendering for that also, with all the risk of the hard work to be done in a very small interval, upon a mere chance of success. The writer happened to have an affair of his own which required half an hour's consultation with one of the firm at the time, and well remembers the scene that burst on him as he opened the door. No conclave of freemasons, who may have gathered together at the incubation of York Minster, or Westminster, or Strasbourg, or Cologne, ever displayed more earnest thought, more persevering energy, than that small band, stripped to their shirts in a hot night of August, planning, drawing, and calculating strength, and stress, and cost, and time, with a will and a purpose that never looked at the contingency, that the labour and expense might be all in vain, and be set aside by a caprice or a formula."

In the following there is something equally truthful and arousing:—

"There exists in the community a considerable number of original-minded men, upon whom the onward progress of the nation wholly depends. By the very constitution of their minds, this class of persons is the reverse of accumulative. They discover and give continually, to all mankind, whether in philosophy, literature, art, chemistry, or mechanics. Their knowledge is above all price, and they cannot hire it out. They ought to be essentially a leisure class, pursuing labours of love, giving books and arts to the world, for which there is no direct payment. A discoverer in optics, it is clear, can be better employed than in becoming a manufacturer of spectacles. We do not want a Liebig to "keep a farm and carters," or a Dalton to retail soda-water or chloriform. We may talk as we please of the duty of all men to be frugal and saving, but it is not so frequently the want of power to save, as want of the strong cupidity that insists on obtaining leave to work, that is the difficulty. A certain refuge from positive want, giving time to work, is frequently the one thing needful. Commonly they need little bodily sustenance, but they need mental sympathy; the want whereof frequently drives them into difficulties. There is needed a metropolitan college for these original-minded men, where they may assemble together without trouble, or expense, or loss of time, where they might mutually benefit by each other's many attainments, and draw around them all the intelligent men of the community seeking to become their disciples. The groves of Academus might be revived; the poets, painters, sculptors, musicians, rhetors, chemists, and mechanics, might therein walk and lecture. Socrates and Plato might reappear. Why not! O Thomas the incredulous! with thy sardonic smile! Men are men now, as ever."

As an example of the writer's plainer style, we give what he tells us about the celebrated American locks, which, for some time during the Exhibition, appeared to claim as much public curiosity as anything in the Crystal Palace—a singular fact, when we reflect that in every lock we see, is printed a stinging satire on our race.

"There are two new kinds of American locks. One by Newell is a "tumbler" lock, analogous to the plan of Chubb, but improved and varied, so as to render it apparently impervious to the picklock. The other, by Jennings, is said to be equally impervious. There are two modes for burglars to open a lock—by violence with gunpowder, or by picking. The latter is a delicate operation. The skin of the fingers is pumice-stoned down, to get delicacy of touch, and mechanical balances are used to find resisting points. Strong electric or other light is introduced, and small refracting mirrors, making clear the whole mechanism. But this can only be done by free key-holes. The key-holes of these two locks afford no entrance for tool, powder, or light. With powder the key-hole only becomes a kind of small pistol barrel, which is shot off without affecting the lock. The principle of safety in these American locks is, that the keys have portions transposable at the pleasure of the owner, who thus practically makes his own lock independently of the smith, the number of changes being several millions in combination."

One who suggests many things has the greater "*chance*" of hitting upon one which shall draw more than ordinary attention; and as the writer of this brochure was the first person to originate the idea of converting the Crystal Palace into a great metropolitan conservatory or winter garden, he claims, upon his own merits, to be heard when he touches upon other matters.

Suggested Works on the Thames: A Letter to the Right Hon. the Lord Mayor and the Court of Aldermen of the City of London. By Marshall Hall, M.D., F.R.S., &c.

Dr. Hall proposes, in almost as few words, to make some astounding improvements in the metropolis: no less than to construct a *Cloaca maxima* under the bed of the Thames on each side of the river, at once to prevent the contamination of the water, and to provide for the fertilization of the land; and, above this, to run a line of railway connected by a bridge over the river at each extremity so as at once to obviate the inconveniences of, and possess all the benefits to be derived from, one large central station of the many railroads that now abound in London. The suggestion must speak for itself.

CORRESPONDENCE.

ON THE IMPROVEMENT OF BOILER SAFETY-VALVES.

In your article on this subject, at page 149, of the October part of the *Practical Mechanic's Journal*, I have met with so much that appears to me to be inaccurate, that I trust you will favour me with a moderate space for commenting thereon.

In the first place, I think the construction of valve shown in fig. 1 of the article in question is by no means common; for, in practice, either the lever bears directly on a rising centre of the valve, or the connecting-rod, or link, is jointed at both ends, and it must be a piece of very sorry workmanship to join in the way shown in your figure; nor could it do so, until partly off its seat, with steam escaping. But some of the remarks in reference to fig. 4, I consider to embody a complete fallacy; for who does not see at once, that if the joint of the lever on the stud is so low down as is represented in the drawing, the smallest motion upwards will throw the connection out of the vertical line, and if the rise goes on, the aberration is rapid? whereas the height of the stud, or stanchion, ought to be equal to the height of the connecting-rod, and then the arc of a circle drawn from the stud-joint as a centre, and cutting the connecting-rod joint in the lever, will vary but little from the perpendicular; and the longer the connecting-rod, and the higher the stud, so that they are both equal, the less will the spindle or tail of the valve be thrown out of perpendicular. Thus, supposing the tail of the valve to be 3 inches long, and the connecting-rod 30 inches, then the deviation of the tail from the perpendicular would be but one-tenth part of what it would be, if the lever were jointed directly to the valve. But a very efficient mode, and not an uncommon one, is, not to joint the valve-*rod* to the lever at all, but simply to allow the rod to rest against the under side of the lever, having a joint on the valve, and a guide above, which construction you appear to have quite overlooked.

Had I time, I might probably be induced to take up some of the notions which I find you have expressed, in reference to the steam opposing itself in passing through the valve. I have no objection to the cone-valve proposed in fig. 4, although I believe it has little to do with the free escape of the steam; and to compare the flow of steam with the flow of water, and to suppose that "the more elastic the fluid, the greater the evil" in checking its progress, are, in my opinion, very loose notions. The same applies also to your comparison of a safety-valve, with the "philosophical curiosity," figs. 2 and 3—and, by the way, the attempted explanation of the phenomenon of that curiosity does not at all commend itself to my notions, albeit I am not at present prepared to hazard a rationale of my own, or to receive any that I have yet met with as satisfactory.

In reference to figs. 5 and 6, I confess that I do not quite understand the writer's proposition; but I gather that he proposes this form to permit a larger escape of steam, without requiring so heavy a weight on the valve. Now, although I do not quite understand the drawing, I may just say, in passing, that I cannot help thinking the author has fallen into some fallacy. Again, in fig. 9, why does he not lower the joint, D, according to the proposition in fig. 4? Referring to the subject of safety-valves generally, my experience and conviction is—that the ordinary valve, well constructed, and on correct mechanical principles, and when in daily use, is quite efficient. When an explosion does occur with such a safety-valve, and boiler of a strength proportioned to the load on the valve, it must arise from a sudden evolution of vapour, for which nothing far short of a safety-valve, something like one-fourth of the area of the boiler, would be sufficient.

Job.

Bristol, 1851.

[We cannot help thinking that our patient correspondent has vainly expended a vastly unnecessary amount of indignation in his review of our exposition of the defects of existing valves, and the good points of those proposed as their substitutes, seeing that the article in question has not the slightest pretensions to the merit of having been written for the purpose of offending his mechanical dignity. Possibly we have not made our meaning quite clear enough; at any rate, not clear enough for "Job."

We do not wish to be understood to flatter our correspondent, when we admit that an extremely superficial knowledge of mechanical principles will enable any one to see that his statement, as to the rapid increase of the versed sine as the radius approaches the perpendicular, is correct, although his illustration of it is somewhat obscure. But if he will again refer to fig. 1, under our guidance, he will find that the short link connecting the lever with the valve is treated as if it were rigid, or in one piece with the lever, otherwise it never could have got into the

position indicated by the dotted lines. He will now, perhaps, discover that the case bears a different complexion; and we have quite enough reliance on his perspicacity to leave him to make a fair decision as to which is the proper position in this case for the fulcrum joint. We do not consider the defect which we have attempted to point out—and we beg "Job's" pardon for not saying so before—any defect at all, apart from careless workmanship and bad attendance; but we have frequently seen the link-joint with the lever fitted so tight as scarcely to be moveable; and, no later than yesterday, we saw one set quite fast with a base compound of rust, oil, and coal-dust. It is on this account, therefore, that we prefer lowering the fulcrum as in fig. 4, so that the bearing point of the link may rise throughout its short traverse as perpendicularly as possible. In fig. 9, the fulcrum is placed in exact accordance with this idea, that is, a little higher than the bearing point, so as to divide the arc which the lever describes equally on each side the horizontal centre line.

We do not deny that, as far as common safety-valves go, very good ones may be, and are, made on "Job's" plan, and on many other plans too; but we repeat and maintain that many exhibit signs of excessive carelessness. As to his assertion that fig. 9 is not a common form, we have to join issue with him, for we think it an extremely common kind of valve, especially on locomotives.

There is little more in "Job's" epistle which is deserving of any reply, as the rest of his observations come to nothing more than a superfluous declaration that he "could if he would,"—which sage conclusion does not tend, in our humble opinion, to the edification of any one. He does, however, condescend to give us the result of a part of his experience, by informing us that a safety-valve, to be really perfect, must have an area not less than one-fourth of that of the boiler itself. Now, practical information of this kind—if to be depended upon—is valuable, but, unfortunately for his pupils, he has forgotten to tell us what he means by the "area of the boiler." In all probability he means the area either of the water-line or the transverse section; but perhaps either will do.—Ed. P. M. Journal.]

MILLER'S RADIATOR AND OPIFER-PERSPECTOR.

The accompanying sketches represent these instruments as shown by me in the Great Exhibition. The "Radiator" is, at first sight, not unlike a common two-foot rule. Fig. 1 is a plan of a portion of the instrument, and fig. 2 is an end elevation. The inner edges of the legs are used as rulers, and the joint has a transparent centre, A, which is placed

Fig. 1.

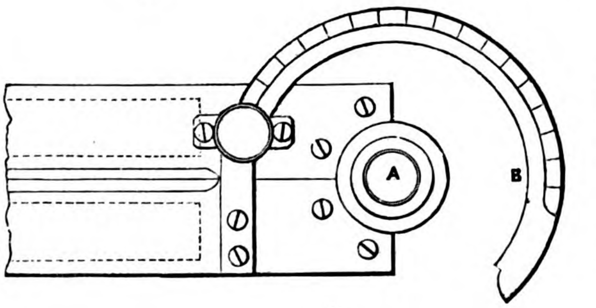


Fig. 2.

1/2

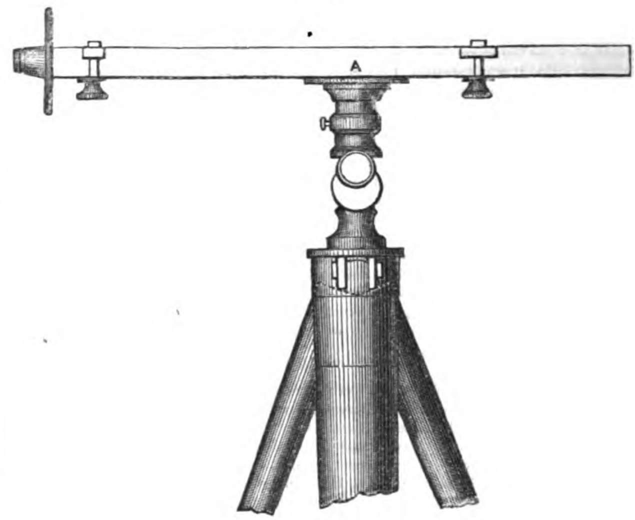
directly over the point to be drawn to. A graduated arc, B, is supplied, and the brass legs are furnished with sockets, which admit of any length of ruler being used. The radiator is applicable to the following purposes:—

For drawing lines in perspective, or geometrical drawing, to a point or centre; for setting off angles as a protractor; for a right-angled triangle, or any other angles; and for setting out polygons of different numbers of sizes. In using it, the centre of the glass is placed over the centre to be drawn to, and a line is drawn along the inner edge of the ruler from the point required. When many lines are to be drawn to one centre, the hand must be placed upon one leg, to allow the other to be moved to the several points.

The "Opifer-perspector" is for taking perspective views of original objects. It is delineated in fig. 3, where A is a drawing-board, placed upon a tripod staff, and grooved and fitted with moveable pivots, on which a ruler traverses, with its edge in a direct line with the centre of the pivot. Simple contrivances are attached beneath the board, to obtain the required elevation and depression of angles of the object to be drawn.

In employing this apparatus, the board, A, is levelled in every direction, and a sheet of paper being laid down and fixed upon it, the edge

Fig. 3.



1-26th.

of the ruler is directed to the various angles of the object, and lines are drawn to the intersecting plane.

For the elevation of objects, the board has only to be placed on its edge, repeating the process just described; and the outlines being delineated, the artist proceeds and finishes his drawing, in accordance with the established rules of perspective.

J. Miller, Junior.

Woolwich, December, 1851.

[Mr. Miller's instruments certainly possess the great merit of simplicity. They promise to be useful for many of the operations of the engineer.—Ed. P. M. Journal.]

LOCOMOTIVE MECHANISM IN THE GREAT EXHIBITION.

I find it necessary to explain myself in reply to "Justitia" and Mr. Sharp, and also to put these gentlemen right.

1. As to the mode of suspending the "Hawthorn," "Justitia" states that this engine has not the tendency to pitch peculiar to ordinary six-wheeled engines, as the latter have the greater portion of the weight suspended on the centre wheels, and may, consequently, swing on them as a fulcrum; whereas, in the former engine, the weight is distributed on four points. This is nothing to the point. "Justitia" may, if so disposed, distinguish between one fulcrum and two fulcrums; but a man of his acumen must be aware that two fulcrums, in some cases, go but a limited way to mend the matter. Take Bury's old engine, for example, on four wheels, or two axles; the circumstance of two fulcrums did not, by any means, keep the engine steady. Take, again, the "long boiler." In its first form—the driving-wheels in the centre—it pitched fearfully, to be sure. In its second form, the driving-wheels being next the fire-box, and the weight thrown mostly on them and the leading wheels, forming virtually two fulcrums, twelve feet distant, it was practically no better. Now, the pitching in both cases was due to the circumstance common to both, that the heavy masses overhung the fulcrums, though, in the second form, the overhang was mostly at the fire-box end. Now we (*you* and I, "Justitia") know well the established principle, that "the less projecting weight there is over the axles, the safer the engines are." But why? Because the spring-base being here considered identical with the wheel-base, there is less of the extra vertical motion, or pitching, due to overhung weight, and permitted by the play of the springs. It is not necessary to go into the fatiguing detail of the apportionment of the engine weight upon the axles; it is enough, I reckon, to show, that a short wheel, or a short elastic base, is not so steady as a long wheel or elastic base; and that though a *short* wheel-base, combined with a short spring-base, may be worse than a *long* wheel-base with a short spring-base, yet that, independently of the wheels, a long elastic base is superior to a short one. This is the gist of the argument, for with all that has been said about the liberty of extending the spring-base of the "Haw-

thorn," it is practically so limited by the necessity of securing a sufficiency of weight on the driving wheels, as not to deserve consideration in respect of the facility for adjusting the element of stability.

But "Justitia" denies that in the "Hawthorn" the shortness of the elastic base is an evil, whatever it may be in other engines; for, says he, "whatever irregularities may occur in the rails, the action of the springs is given out at the four points of suspension, hence the whole weight acts upon them parallel to a straight line of railway." It is not so ordered. For example, when the leading wheel sinks into a bad joint, the following ensues:—The fore end of the compensating beam, which we shall call No. 1, sinks also, and it turns on the joint under the driving axle-box as a fulcrum; it thus eases away from the leading spring, and, so far, the beam and spring No. 2 are unaffected. But the spring being thus partially unsupported, and its load also, down comes the front end of the engine to restore its full bearing on the spring and the beam, and *then only*, after the pendulous mass is set agoing, does the spring No. 2 become affected—as the fore end plunges, the hind end rears; No. 2 spring is lightened, and No. 1 is momentarily overloaded. A reaction takes places—the front rears, and the back plunges; this is the essence of "see-saw, Margery Daw," and, in mechanical language, the engine pitches.—Q. E. D. It is true, that of any given depression of the fore end of beam No. 1, only one-half is communicated to the butt of the spring. But what a cruel overhang there is in front, and how formidably must even a slight pitch operate with such tremendous leverage! Verily, I should have thought that "overhanging" objections were at this day more fully appreciated.

2. As to the equilibrium slide, I regret I did not say something, as "the same must have been peculiarly gratifying" to "Justitia."

3. As to the link: when an engine is put forward as the embodiment of good things, the direct test, and, I may add, the least troublesome, is to take the results as we find them in the authenticated example. On this principle, I appealed at once to the excellent representation of the engine published by you, sinking details, and instituted my comparisons. The fact of the comparison being unfavourable, or, at the utmost, indifferent for the new link, even though it was compared with the shifting link, showed that the possible difference in favour was a matter of insignificance; and, in truth, the height of boilers with inside cylinders is regulated mostly by the clearance for the cranks and the connecting-rod ends. There is no doubt that, *cœteris paribus*, the new link requires an inch or two less headroom than a shifting link; but, with kind regards to "Justitia," this I never denied. On the other hand, the ordinary stationary link requires, *cœteris paribus*, an inch or two less headroom than the new link; and, in short, the new link can be viewed only as an elaborate trifle.

On the subject of lead, "Justitia's" remarks only show that he has not studied the question. In the first place, the steam indicator proves that the lead which is sufficient for full gear, is, *in all cases*, more than sufficient for expansive working. It is superfluously so, because the more expansively you work by shortening the travel, the sooner does the port open for steam, previous to the commencement of the steam-stroke, *even with constant lead;* and accordingly, the indicator proves that, under high degrees of expansion, violent regurgitations of the steam take place, even at the highest speeds, owing to the premature entrance of steam against the piston, while yet the latter has to complete the returning stroke. Moreover, the higher the degree of expansion, the sooner does the exhaust side of the valve close the port for the escape of steam, and therefore the greater the amount of steam detained and compressed, until, for the utmost expansion, the compressed steam may actually exceed in pressure the steam from the valve-chest, and be *pushed out of the cylinder*. How unnecessary, then, to provide for free access to the cylinder by increase of lead! Again, as to improving the exhaust by adding to the lead, the practice is reprehensible, as it clearly creates injurious counter-pressure on the piston, by admitting the steam too soon. That the exhaust is so improved is certain, but the object is equally well accomplished by adding as much to the lap—an expedient at once elegant and efficient, whilst it does not add to the resistance from steam too early admitted. But, further, an engine which exhausts well in full gear, exhausts even better under the expansion, as the more expansively the steam is worked, the earlier does the port open for exhaust; and, in fact, with any link you like, this reduction of back pressure, which is the only measure of the quality of the exhaust, is confirmed by direct observation by the indicator.

Provision for cutting off the steam equally for the front and back strokes is a matter only of detail, and is effected by a mere adjustment of the centres of suspension and connection with the eccentric-rods. Intelligent of these circumstances, many engineers have *not* condemned the suspended link, but have, on the contrary, retained it, and nobody besides "Justitia," and John Grey, of variable-expansion celebrity, have to my knowledge ever claimed a superiority for the shifting link, on the ground of the variable lead which it affords. To me it is a matter of the most perfect indifference what "Justitia" or Clark may think of Gooch's link. The box, or any other link, may be used in the same motion with equal propriety, and if "Justitia" choose to diverge from the question before him, to discuss a matter of circumstance, I am very careless as to the results of his investigations. But if he maintain, that in Gooch's link, or any other one, the steam can *not* be cut off equally for the front and back strokes, it again follows that he has not studied the question. He refers me to Tredgold for Hawthorn's link there published; I have industriously examined plates 1, 2, and 3, which are all that the discriminating publisher has chosen to issue, and I find that the link-motion is not to be seen. I suppose "Justitia" knows all about it independently of Tredgold, and I must acknowledge his advocacy to be a very good piece of special pleading, which might possibly have been improved, had he exhibited less talent for the use of superfluous expletives.

Turn we now to Mr. Sharp. He complains of my having stated, that he reasoned from the necessities of steam of only *double* pressure. I simply referred to his own remarks on this point, when he says that "in locomotives the pressure is seldom less than 100 lbs. per square inch, being about double the pressure in use not more than ten years ago," which I hope is quite legitimate.

His remarks on my notions about steam, as they are irrevelant to the question, I need not notice, further than that he has made a misquotation, which may, however, be trifling. We shall see. He quotes me thus:—"The higher the pressure of steam to be exhausted, the greater, in the same proportion, is the *force* of exhaust;" prefixing that I accuse him of making this assumption. Now, I mentioned the *effort*, not the force, of exhaust. That the force increases with the pressure is a truism, for force and pressure are, in this case, synonymous; but the *effort* refers to what is required to be done with the given force or pressure. A reference to my previous communication will show that I laid the stress of the argument on Mr. Sharp's assumption, that this effort increased *in the same proportion* with the pressure; and I then showed that the effort did *not* increase in the same proportion, from the circumstance that the velocity of the free escape of steam into the atmosphere, *increases very materially* with the pressure,—that is, the pressure of strong steam has a greater command over the mass of steam to be expelled, and sends it forth with greater velocity than that of weak steam is able to do; and you will perceive that this is a material point in the argument. But does a conclusion of this kind imply, "that high-pressure steam exhausts in less time than low pressure?" Certainly not, and Mr. Sharp has ably relieved me of what I should have thought a very unnecessary piece of business—in proving that the higher the pressure, the longer the time required for exhaust.

On the question of back pressure in the "Great Britain," Mr. Sharp makes some remarks on the relation of back pressure to what he supposes the pressure of the steam at the end of the steam-stroke. But nothing of importance can be thus inferred beyond the general result, that the mean back pressure resulting from imperfect exhaust is commonly not much less than that of the steam at the end of the steam-stroke. In the cases quoted, the terminal pressure was only 15 lbs., and not 60 lbs., for the 10 lbs. of back pressure in full gear; and for the 5th notch, the terminal pressure was but 2 lbs. Arguments founded on these final pressures are irrelevant, and I prefer comparing the back pressure with the pressure of the steam in the cylinder while being admitted, consistently, indeed, with Mr. Sharp's own terms of comparison, when he alludes to the 40 lbs. of back pressure for 80 lbs. steam. Whatever may have been the state of valve-gear at the time this observation was made, this I do know, that with Stephenson's ordinary proportions of cylinder and valve, having 1 inch of lap, ¼ inch of lead, and 4½ inches of travel, with a 4½ inch blast-pipe, a practically perfect exhaust may be and is obtained at speeds of 40 miles per hour, and there is nothing to hinder the adoption of proportions quite as good as those of the "Great Britain" for all classes of engines.

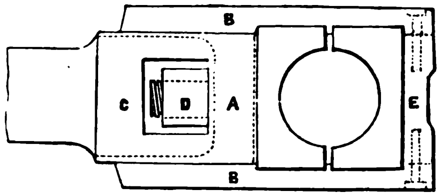
HELIX JUNIOR.

December, 1851.

BUCHANAN'S CONNECTING-ROD END.

In the last part of the *Practical Mechanic's Journal*, is a new form of connecting-rod end, by Mr. J. D. Humphries, and as the subject is worthy of attention, I have sent you a sketch of a plan which I devised some time ago, for the purpose of saving the space between the rod end and the boiler in locomotives. It has never been put into execution, but I believe would be found to answer.

The sketch is a side view of the rod end. The transverse bar dotted in at A, connecting the two straps, B, slides in a recess in the head, C, of the rod. To this bar is attached a screw, fitted with a nut, D, so that the bar and strap may thus be adjusted in or out. A separate transverse piece, E, is fitted on in front, after the brasses are put in their places, being held in position by four screw-bolts. On working the nut, D, this piece, E, presses on the front brass, and causes it to bear close up on the crank pin.



W. Cross Buchanan.

Glasgow, December, 1851.

[There is at least one evident objection to Mr. Buchanan's arrangement. He relies entirely on the lateral strength of the front end piece, E, and its holding bolts. We are afraid this rod end would neither be so neat, nor so effective, as that of Mr. Humphries, whilst it appears to be more difficult of execution.—Ed. P. M. Journal.]

DISCONNECTING APPARATUS FOR PADDLE-WHEELS.

Having frequently observed, in the pages of the *Practical Mechanic's Journal*, suggestions for the improvement of the old friction clutch, it has occurred to me that it might be made practically available for disconnecting the paddles of steamers. The arrangement which I am now about to describe, renders it very easy of management, and instantaneous in its effects. Fig. 1 is a side elevation of a marine engine crank-shaft and friction disc; and fig. 2 is a corresponding end view, looking on the face of the friction disc. The disc-wheel, A, keyed fast on the paddle-shaft, has a friction-ring, B, and crank-pin eye attached; and in the disc, at particular angles, are cast the slots or recesses, C and D, to receive the bolts or catches, E F. On the ring, B, are also cast the notches, G H, to receive the bolts, E F, for the purpose of backing and driving, being kept in position by the helical springs at the lower part of the seat, serving at the same time to throw the catches into the recesses at any position of the crank; and when it is intended to drive the paddles, the handle, J, is loosened, and the catch flying into the notch in the ring, carries round the crank. In backing—when the engines are reversed—the action of the inclined planes throws the catch, F, down, and frees the backing catch, E, and the action goes on. Lastly, in disengaging, the engines are brought to an intermediate position, to throw both catches out; and by the mere movement of the handles, the catches are fixed, and the paddles are disengaged.

Fig. 1.

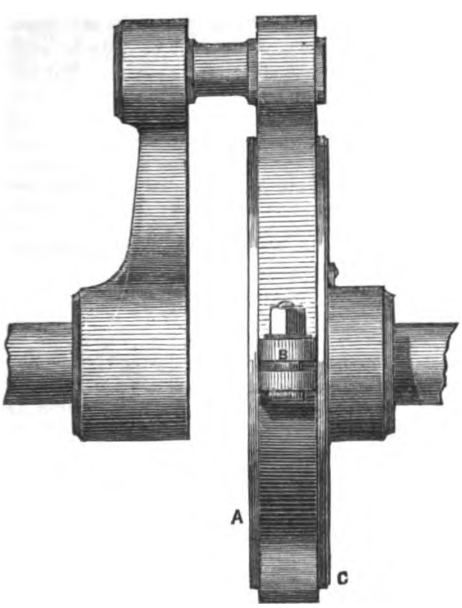
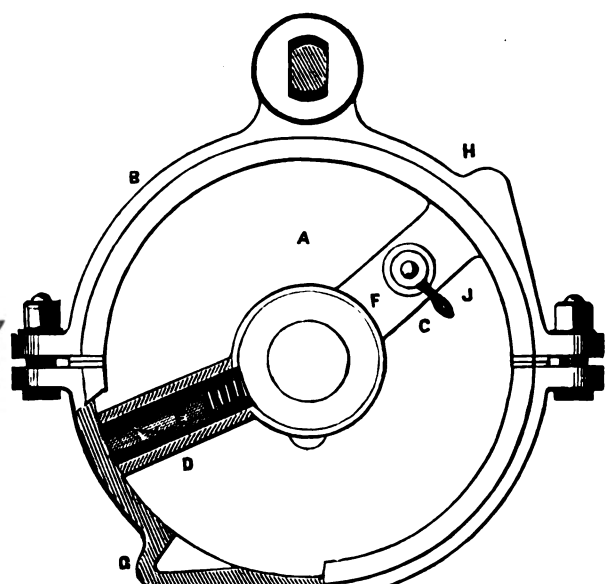


Fig. 2.

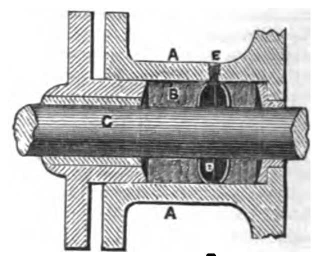


Glasgow, December, 1851. A Constant Subscriber.

LUBRICATING MECHANISM.

In your notices of recent patents, in the *Practical Mechanic's Journal* for this month, we see one by Mr. H. C. Hurry of Manchester, having for its object the better lubrication of machinery, and, amongst other applications, it is adapted for the stuffing-boxes of steam cylinders. Now, this is by no means a new thing, as it has long been generally used in Cornwall, and also by ourselves in London, though the form which we make use of is slightly different to Mr. Hurry's plan, as shown in the accompanying sketches. Fig. 1 is a longitudinal section of the stuffing-box, A; B, being the hemp, or other packing. Fig. 2 is a plan of the lubricating disks, and a portion of the piston-rod. C, Is the piston-rod, and D D are two dished gun-metal rings, turned to fit the inside of the stuffing-box, and bored slightly larger than the piston-rod, which passes through them. A slotted hole, F, is bored in the upper side of the rings to admit the oil, which can only escape through the packings. We make the "lantern," as it is called, in two pieces, for convenience in cleansing, as, should any dirt find its way in, the outer half only must be removed to reach it. and the remainder of the packing is left undisturbed.

Fig. 1.



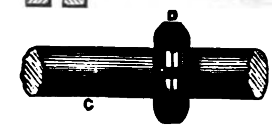


Fig. 2.

Putney, London, December, 1851. Hodge & Batley.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

October 22, 1851.

After the preliminary business connected with the nomination of officers for the ensuing year, the following papers were read:—

"On the direct conversion of Rectilinear into Circular Motion in the Steam Engine," by Mr. J. A. Shipton.

"On the Preservation of Timber by Creosote," by Mr. J. E. Clift.

"New Equilibrium Canal Lift for transferring Boats from one level to another without loss of water or of power," by Mr. A. Slate.

"On an Improved Miner's Safety Lamp," invented by Mr. Eloin of Belginm, by Mr. S. H. Blackwell.

November 18.

"Description of a new Metallic Manometer, and other instruments for measuring pressures and temperatures," by M. Engine Bourdon of Paris.

[We have fully described this ingenious invention elsewhere.]

Mr. Pole afterwards exhibited and explained an instrument of his invention, called the "Prismatic Clinometer," for measuring angles of elevation and depression. It was an application to vertical angles, of the principle of Captain Kater's prismatic compass, in which the angle is read by a prism, at the same time that the sights are directed to the object.

Mr. C. May directed the attention of the meeting to some specimens of iron ore, now being extensively raised, in the neighbourhood of Middlesbro'-on-Tees, by which as great a revolution would, probably, be caused in the iron trade of the

North of England, as the discovery of the black-band ore in Scotland had produced some years since. The ore was found in a bed of 15 to 18 feet in thickness, close to the surface, amidst cheap fuel, and within a few miles of a seaport; and as it contained from 33 to 35 per cent. of iron, its advantages were already so fully estimated, by the proprietors of some iron-works where there were eleven blast furnaces, that they had ceased working their former mines, and conveyed this ore a distance of fifty-five miles by railway, with advantage to the quantity and quality of the iron produced.

NOVEMBER 25.

"On the application of Machinery to the manufacture of Rotating Chambered-Breech Fire-Arms, and the peculiarities of those Arms," by Col. Samuel Colt, U.S. America.

This was the first American communication that had been brought before the Institution, and it was received with acclamation; and in the discussion which ensued, in which the Honourable Abbot Lawrence (United States Minister), Captain Sir Thomas Hastings, R.N., Captain Sir Edward Belcher, R.N., Captain Riddell, R.A., Mr. Richards, Mr. Miles, and the Members of the Council took part, the most flattering testimony was given of the efficiency of the Colt revolvers in active service, and the strongest opinions as to the necessity of their use in all frontier warfare; and that, without this arm, it was almost impossible, except with an overwhelming force of troops, to cope with savage tribes.

[In the course of the description of the barrels of his pieces, the author stated that "the grooves were of a peculiar spiral, commencing almost straight near the breech end, and terminating at the muzzle in a curve of small radius." This form was long ago introduced by Mr. Kennedy of Kilmarnock, for whom we have claimed the credit of the invention, in the "Monthly Notes" of our present part. —ED. P. M. JOURNAL.]

DECEMBER 2.

The discussion on Col. Colt's paper was renewed at this meeting.

DECEMBER 9.

"An Account of the Works on the Birmingham Extension of the Birmingham and Oxford Junction Railway," by Mr. C. B. Lane.

ROYAL SCOTTISH SOCIETY OF ARTS.

The 31st session of this society was opened on the 10th of November, by Mr. Grainger, the president, who delivered a valuable and interesting address, in which he briefly referred to the character and services of several fellows and members deceased during the past year—the Great Exhibition—and the cultivation of flax in Scotland. We regret that we cannot afford room this month for a more extended notice of these excellent remarks.

Professor C. P. Smyth then made an oral communication "On the application of Wind to the raising of Water for irrigation in the Colonies;" and the prizes were awarded to the successful candidates of the past session.

NOVEMBER 24.

Dr. Lees, the new president, opened the meeting with a brief address, after which an "Account of Observations on the Solar Eclipse of July 28, 1851, made at Sebastople," was read by Professor Edward Sang. This paper was followed by one upon an "Improved Anemometer," by Mr. W. C. Buchanan. The object of the author in this suggested improvement of the wind-guage is to remove, as far as possible, friction from the working parts.

DECEMBER 8.

"Description and drawing of Public Baths and Wash-houses at Hawick," by Mr. J. Goodfellow. "On a Self-acting Railway Signal," by Mr. J. G. Winton, Leith. "Suggestions for the Improved Manufacture of Sheet-Iron," by J. M. Wakes of Macon. "On an improved Jointed Artificial Leg for Short Stumps," by Mr. F. Howell, Edinburgh.

MONTHLY NOTES.

NEW DOCK AT SOUTHAMPTON.—A new dock, having an area of about ten acres, has just been opened for general business at Southampton. This dock, which has been partially excavated for many years, adjoins the tidal basin of the Southampton docks, which has hitherto been the only dock accommodation in existence here, and which has been found to be wholly inadequate for the large and increasing commerce of the port. In view, therefore, of the greatly augmented traffic, and of the increase of business expected from the establishment of new lines of steam communication with various parts of the world, and also in consequence of the additional room required in the tidal basin for the larger class of steam-ships now preparing for the West India and East India mail-packet service, by the West India and Peninsular and Oriental Steam Navigation Companies, the directors of the Southampton Dock Company determined to complete a new dock, the excavations for which had already been commenced at the first establishment of the company, but discontinued from want of funds and other causes. The area of the new dock is estimated in round numbers at 10 acres; the entrance from the open dock or tidal basin is 46 feet wide, and is furnished with one pair of gates (no lock), the height of water inside being regulated as regards the incoming tide by a sluice through the sea-bank; the depth of water over the sill will be 25 feet at springs, and 21 feet at neap-tides; and these depths will be maintained inside, varying only with the difference of rise between the springs and neaps. The entrance is crossed by means of a running bridge, which, upon being opened, disappears beneath a vertebrated platform, leaving neither gap nor projection when shut. The bridge has a line of rails, a cart road, and footways over it; is very simple in its construction, and is altogether a new invention. The dock has stone walls on two sides only, the remaining sides being merely sloping banks, against which vessels lying up will be moored. The length of quay wall, including the entrance, is 1,700 feet. The quays are furnished with Fairbairn's patent tubular cranes, and have lines of railway running so close to them, that coals and merchandise can be whipped from the vessels into the waggons. New warehouses, for various purposes, with vaults and extensive coal sheds, are being erected near the quays of the new dock, and the trade of the port will thereby possess greatly increased facilities for loading and unloading, compared with what are afforded in the tidal dock. The whole of the new works have been carried out by Mr. Alfred Giles, the company's engineer, without a contract, and the cost is supposed to be very moderate; the dock alone, without warehouses, having cost about £18,000; the dock walls, 35 feet in height from the coping, costing only £6. 10s. per lineal foot.

MULLER'S PHOTOGRAPHIC PROCESS.—Mr. C. J. Muller of Patna, in the East Indies, has just added another chapter to the history of photography, in the form of a new process resembling the catalissotype of Dr. Woods. A solution of hydriodate of iron is made, in the proportion of eight or ten grains of iodide of iron to one ounce of water. This solution is prepared in the ordinary way, with iodine, iron-turnings, and water. The ordinary paper employed in photography is dressed on one side with a solution of nitrate of lead (15 grains of the salt to an ounce of water). When dry, this paper is iodized either by immersing it completely in the solution of the hydriodate of iron, or by floating the leaded surface on the solution. It is removed after the lapse of a minute or two, and lightly dried with blotting paper. This paper now contains iodide of lead, and protonitrate of iron. While still moist, it is rendered sensitive by a solution of nitrate of silver (100 grains to the ounce), and placed in the camera. After an exposure of the duration generally required for Talbot's paper, it may be removed to a dark room. If the image is not already out, it will be found speedily to appear in great strength, and with beautiful sharpness, *without any further application.* The yellow tinge of the lights may be removed by a little hyposulphite of soda, though simple washing in water seems to be sufficient to fix the picture. The nitrate of lead may be omitted; and plain paper only, treated with the solution of the hydriodate of iron and acetic acid, may be used with the nitrate of silver, which renders it more sensitive. The lead, however, imparts a peculiar colorific effect. The red tinge brought about by the lead may be changed to a black one by the use of a dilute solution of sulphate of iron—by which, indeed, the latent image may be very quickly developed. The papers, however, will not keep after being iodized. Mr. Muller further suggests, that as iodide of lead is completely soluble in nitrate of silver, it might furnish a valuable photographic fluid, in readiness for use at any moment. This contribution from Central India is stated to be easy of manipulation and certain in its results, and appears to be quite applicable to the albumenized and collodionized glass processes.

GREAT NORTHERN RAILWAY.—The principal front of the new terminus at King's-cross, facing Liverpool-street, New-road, and the numerous railway offices adjoining, are as yet in an unfinished state, but the works are rapidly progressing. The principal front extends 216 feet, and is flanked with side towers, each 71 feet high. The centre tower, in which is the principal entrance, is above 100 feet high. In this tower, at a height of 90 feet from the ground, will be placed a large clock, the dials (three) of which will be each 27 feet in circumference. The arrival and departure sheds are each 800 feet long, by 105 feet wide, from wall to wall; the roofs of these sheds are semicircular, each 71 feet high to the crown of the arch; the arched frames which support the roofs are constructed of wood, with iron plates firmly embedded and strongly bolted together; these have a span of 105 feet, and are 40 in number, to support each roof, being 20 feet apart; they rest on piers of cast-iron, cased with brickwork; the roofs will be composed of thick plate-glass, corrugated zinc-plate, and galvanized iron, with ventilators at intervals to let off the steam and smoke when engines are waiting underneath. The refreshment rooms are spacious and lofty, and are adjoining to the waiting-room. There will be an extensive hotel attached to the refreshment rooms, for the accommodation of passengers, and a news-room and bookseller's shop.

INDUSTRIAL PROGRESS OF AMERICA.—Under the tariff of 1842, the American exports were equal to 113,488,516 dollars; in 1851, and under the tariff of 1846, they reached 195,896,650 dollars. The revenue of the tariff of 1842 was 26,712,000 dollars; last year, under the tariff of 1846, it was 50,000,000 dollars. As regards shipping, the tonnage for 1846 was 2,652,000 tons, for 1851 it was 3,780,000 tons. The vessels built from 1842 to 1846 were 500,000 tons, from 1846 to 1851 they were 1,090,000 tons. Whilst railroads of the aggregate length of 1,862 miles had been made from 1842 to 1846, from 1846 to 1851 6,000 miles had sprung into existence. The coastwise tonnage of 1846 was 1,117,000 tons, of 1850, 1,431,000 tons. This is progress indeed.

KENNEDY'S NEW RIFLE BARREL.—Somewhere about a year ago, Mr. Thomas Kennedy, a gunmaker of repute in Kilmarnock, proposed to us to construct the barrels of rifles with differential spiral gooves, that is, with grooves commencing from the straight at the breech, and gradually increasing spirally, until they terminated, at the muzzle, in spirals equal to one turn in eight feet. Mr. Kennedy has made several such rifles, by the assistance of a rifling machine, designed and constructed for this especial purpose. He finds that such a barrel carries a charge one-third farther than the ordinary barrel with the same elevation, whilst it loads easier, has less recoil, and is free from all risk of stripping, even with the heaviest charge. We have thought fit to mention Mr. Kennedy's invention here, because we find that Colonel Colt describes a similar arrangement as his own contrivance, at the Institution of Civil Engineers, on the 25th of November last.

ENGLISH PATENTS.

Sealed from 14th November, to 11th December, 1851.

William Charles Scott, Camberwell, gentleman,—"Certain improvements in the construction of omnibuses and other public and private carriages."—November 15th.

James Lott, Whitchurch, Southampton, saddler,—"Improvements in harness and fastenings."—15th.

Charles Ewing, Bodorgan, Anglesea, steward and gardener,—"An improved method or methods of construction applicable to architectural and horticultural purposes."—15th.

Claude François Tachet, Paris, mathematical instrument maker,—"Improvements in preparing wood to prevent its warping or shrinking."—15th.

Pierre Erard, Gt. Marlborough-street, Middlesex, piano-forte maker,—"Improvements in piano-fortes."—15th.

Antoine Dominique Sisco, Slough,—"Improvements in the manufacture of chains, and in combining iron with other metal applicable to such and other manufactures."—15th.

William Hamer, Manchester,—"Certain improvements in weaving textile fabrics."—15th.

Henry Bessemer, Baxter House, St. Pancras,—"Improvements in producing ornamental surfaces on woven fabrics and leather, and rendering the same applicable to bookbinding and other uses."—19th.

Frederick Joseph Bramwell, Millwall, engineer,—"Improvements in working the valves of steam-engines for marine and other purposes, and in paddle-wheels."—20th.

Thomas Statham, Sidney-street, City-road, piano-forte maker,—"Certain improvements in piano-fortes."—20th.

Joseph Sharp Bailey, 3 Victoria-terrace, Keighley, York, machine woolcomber, and Isaac Bailey, Victoria-street, Bradford, York, book-keeper,—"Certain improvements in preparing, combing, and spinning wool, alpaca, mohair, and other fibrous materials."—20th.

Samuel Colt, Bond-street, Middlesex,—"Certain improvements in fire-arms."—22d.

Thomas Marsden, Salford,—"Improvements in machinery for heckling and combing flax and other fibrous materials."—22d.

Enoch Statham, Siddal's-road, Derby,—"Improvements in the manufacture of lace and other fabrics."—22d.

Frederick Weiss, Strand, Middlesex, surgical instrument maker,—"Improvements in certain surgical instruments, also in scissors and other like cutting instruments."—(Communication.)—22d.

Frederick Benjamin Geithner, Camden-street, Birmingham,—"Improvements in the manufacture of castors and legs of furniture."—22d.

Jean Baptiste Chaluren, Rouen, merchant,—"Improvements in preparing and weaving cotton."—22d.

William Armand Moreau Gilbée, 4 South-street, Finsbury-square, London, gentleman,—"Certain improvements in the process of, and apparatus for, treating fatty and oleaginous matters, and in the manufacture of candles and other useful articles therefrom."—(Communication.)—22d.

George Mills, Southampton, Hants, engineer,—"Improvements in steam-engine boilers and in steam-propelling machinery."—22d.

Alexander Southwood Stocker, Wandsworth, Surrey, gentleman,—"Certain improvements in the stoppering or stopping of bottles, jars, pots, or other such like receptacles."—25th.

Henry Ellwood, of the firm of J. Ellwood & Son, Gt. Charlotte-street, Blackfriars, hat manufacturers,—"Improvements in the manufacture of hats."—27th.

Richard Whytock, Edinburgh,—"Improvements in applying colours to yarns or threads, and in weaving or producing fabrics when coloured or party-coloured yarns or threads are employed."—27th.

John Lee Stevens, Kennington, Surrey, gentleman,—"Certain improvements in propelling vessels on water."—27th.

William Exall, Reading, Berks, engineer,—"Improvements in certain agricultural implements, and in steam-engines, and boilers for driving the same."—December 1st.

George Laycock, late of Doncaster, York, but now of Albany, New York, America, dyer,—"Improvements in unhairing and tanning skins."—1st.

William Grayson, Henley-on-Thames, Oxford, watch and clockmaker,—"An odometer or road-measurer, to be attached to carriages for showing distances over which the wheels pass."—1st.

Thomas Burstall, Lee-crescent, Edgbaston, Warwick, civil engineer,—"Certain improved machinery for manufacturing bricks and other articles from clay alone, or mixed with other materials."—1st.

John Mackintosh, Berners-street, Middlesex, civil engineer,—"Improvements in steam-engines, in rigging and propelling vessels, and facilitating their progress through water."—4th.

William Wood, Oxford-street, Middlesex, carpet manufacturer,—"Improvements in the manufacture and ornamenting of carpets, rugs, and other fabrics."—4th.

James Thomson and Frederick Altroe, Compton-street, Brunswick-square, bakers,—"Certain improvements in the means of and apparatus for heating ovens."—5th.

Joseph Harrison, 10 Oxford-square, Hydepark-gardens, engineer,—"Certain improvements in steam-engines."—8th.

Peter Armand Lecomte de Fontainemoreau, South-street, Finsbury-square,—"Improvements in the apparatus for kneading and baking bread and other articles of food of a similar nature."—(Being a communication.)—8th.

Richard Archibald Brooman, of the firm of J. C. Robertson and Co., Fleet-street, patent agent,—"Certain improved modes of applying electro-chemical action to manufacturing purposes."—(Being a communication.)—8th.

Richard Archibald Brooman, of the firm of J. C. Robertson and Co., Fleet-street, patent agent,—"Improvements in the manufacture of sugar, in the preparation of certain substances for such manufacture, and in the machinery or apparatus employed therein."—(Being a communication.) 8th.

Isaac Alexander, 112A, High Holborn, Middlesex, biscuit baker,—"A mode of preparing and treating certain kinds of cheese, whereby to render the same applicable to a variety of culinary and other domestic purposes."—8th.

Perry G. Gardiner, New York, civil engineer and machinist,—"Improvements in the manufacture of malleable metals into pipes, hollow shafts, railway wheels, or other analogous forms, which are capable of being dressed, turned down, or polished in a lathe."—8th.

Charles Cowper, Southampton-buildings, Chancery-lane,—"Improvements in separating coal from foreign matters, and in apparatus for that purpose."—(Being a communication.)—8th.

William Pidding, Strand, gentleman,—"Improvements in the treatment, manufacture, and application of materials or substances for building purposes."—8th.

John Lake, Apsley, Hertford, civil engineer,—"Improvements in propelling on canals and rivers."—8th.

Thomas Restell, Strand, Middlesex, watchmaker,—"Improvements in locks or fastenings."—8th.

John Frearson, Birmingham,—"Improvements in cutting, shaping, and pressing metal and other materials."—10th.

James Webster, Leicester,—"Improvements in dyeing gloves and other articles of hosiery."—10th.

Etienne Alexander Armand, Paris,—"Improvements in the modes of distilling and treating organic substances and bituminous matters, and in the treatment of their products, together with the apparatus used for the said purposes."—10th.

Alfred Vincent Newton, Chancery-lane, mechanical draughtsman,—"Improvements in dyeing textile fabrics."—(Being a communication.)—10th.

Thomas Masters, Regent-street, confectioner,—"Improvements in obtaining and drawing off aerated and other liquids, and in charging vessels with gaseous fluids, applicable to vessels for holding solid matters, and also as a fastening for utensils and apparatus, and in holders for cigars."—11th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 14th November, to 11th December, 1851.

Nov. 14th,	3018.	T. and T. C. Robson, Liquorpond-street,—"Double-bevelled iron for solid hoop wheel-tyre."
15th,	3019.	Arthur Craven, Stamford-hill,—"Feeding apparatus for steam boilers."
17th,	3020.	Samuel Williams, Commercial-road, Lambeth,—"Derrick lift."
21st,	3021.	William Ashton, Louth,—"Universal sponging bath."
—	3022.	J. and A. Ridsdale, Minories,—"Fastening for ships' scuttle-light and ports."
—	3023.	S. M. Feary, Willingham,—"Wheel supporter."
22d,	3024.	I. Biggs and Son, Leicester,—"Shirts made of looped fabrics."
24th,	3025.	William Barwell, Birmingham,—"Metallic reel."
25th,	3026.	Robert M'Connell, Glasgow,—"Water-closet."
—	3027.	J. W. and T. Allen, Strand,—"Despatch-box."
26th,	3028.	Henry Watson, Newcastle-on-Tyne,—"Parts of a safety-lamp."
—	3029.	William Dray, Swan-lane, City,—"Bullock-tie."
—	3030.	Dent, Allcroft, & Co., Wood-street, Cheapside,—"European collar fastening."
27th,	3031.	Samuel Hemming, Bristol,—"Combined lactometer and milk vessel."
—	3032.	William Hodgson, Bradford,—"Spool motion."
28th,	3033.	Robert Adams, King William-street,—"Projectile."
29th,	3034.	Moses Wright, Yorkshire,—"Shuttle."
Dec. 1st,	3035.	William Marr, Cheapside,—"Improved girder."
2d,	3036.	G., A., & F. Ferguson, Poplar,—"Compresser for gun-carriages."
—	3037.	John Gillam, Woodstock,—"Seed-cleanser and separator."
3d,	3038.	T. B. W. Gale, Homerton,—"Boring tool."
—	3039.	Thomas Paris, Greenwood, Barnet,—"Brick."
—	3040.	Thomas Paris, Greenwood, Barnet,—"Brick."
4th,	3041.	John Sanders, Birmingham,—"Adjusting lock-furniture."
—	3042.	Wolf and Baker, Basinghall-street,—"Condensing tobacco-pipe stem."
—	3043.	Richard Garrett, Saxmundham,—"Reciprocating knife for reaping machine."
—	3044.	James Slipper, Leather-lane,—"Bronchitis tube."
5th,	3045.	George Sant, Fulham,—"Milk-tester."
—	3046.	Francis Wisshaw, John-street, Adelphi,—"Telekouphonon."
—	3047.	Maurice Moses, Tower-hill,—"Janus coat."
6th,	3048.	J. C. Evans, King William-street,—"Revolving curtain-runner."
—	3049.	E. N. Fourdrinier, Sunderland,—"Penholder."
8th,	3050.	John Hicks, Dorchester,—"Dorset stove."
—	3051.	W. Flataw & Co., Mansell-street,—"Shoe."
9th,	3052.	Henry Stephens, Stamford-street,—"Parallel ruler."
—	3053.	Cripps and Lindup, Worthing,—"Duobus coat."
10th,	3054.	—— Lyon, Windmill-street,—"Sausage-meat cutter."
—	3055.	Charles Clarke, Birmingham,—"Casement stay and fastener."
11th,	3056.	D. Thornton & Son, Birmingham,—"Glass guage-tube for railway engines."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 14th November, to 11th December, 1851.

Nov. 14th,	324.	T. E. Jones, Birmingham,—"Improvement in the solar shade."
—	325.	Alfred A. Hely, C. E., Westminster,—"Anti-pickpocket or pocket-protector."
—	326.	Walter de Winton, Lambsconduit-place,—"Brougham cab."
15th,	327.	M. Cavanah, Notting-hill,—"Adjusting lock-spindle."
—	328.	Thomas Harrison, Liverpool,—"Prince of Wales' piano-forte."
21st,	329.	J. S. Long, Westminster,—"Perambulator."
25th,	330.	Isidore Burnsteen, Essex-street, Strand,—"Travelling coat."
26th,	331.	F. G. Yeates, East-road, City-road,—"Winder for boxes for string, twine," &c.
27th,	332.	George Levaison, Cavendish-square,—"Valved catheter plug."
28th,	333.	H. W. Atkins, Birmingham,—"Burglary preventive shutter furniture."
29th,	334.	B. Clark, M. R. C. S., Hampstead,—"Sewer-stopper."
—	335.	G. P. Cooper, Pall-Mall East,—"Elliptic waistband."
—	336.	James Leetch, York-road,—"Revolving curtain-runner."
Dec. 10th,	337.	John Sutton, Newington,—"Bulbous root-holder, and flower support."
—	338.	Marcus Davis, Strand,—"Geometer."
11th,	339.	Cyrus and J. Clark, Somerset,—"Expanding boot."

TO READERS AND CORRESPONDENTS.

RECEIVED.—"On the Construction of the Building for the Great Exhibition." By M. D. Wyatt.—"Reports of the Commissioner of Patents, U. S., 1850."—"Loseby's Improvements in Time-keepers."—"Portuguese Exhibition."

A BEGINNER, HAMMERSMITH.—We are afraid we cannot conscientiously congratulate him on his "proficiency in the working parts of the steam-engine," but we must not be hard on "a beginner." If an engine stops on the dead centre, the crank must, of course, be pushed past this point by some external power, before the steam pressure will put it in motion. Read any elementary book on the steam-engine.

SCRIPTOR.—Mr. Mallach's pens are composed of several parts, the nibs, the stem or barrel, and the points. The two nibs, which are manufactured separately in a machine for the purpose, and afterwards connected by the intervention of the stem, are formed of an alloy of gold, silver, platinum, and copper, in such proportions, that they retain a golden appearance, whilst they are perfectly elastic. The stem, to which they are riveted, is composed of platinum and silver. The points are made of ruby, and another and still harder substance, *osmiuret of iridium*. This alloy is obtained from platinum ore in the granular state, is soldered to the extremity of each nib, and then ground to shape by emery and diamond dust. The ruby points are attached in the usual way to the ends of the nibs, and then ground.

"Radical and Curved Vanes for Centrifugal Pumps."—In reference to our article on this subject, in the December part of the *Practical Mechanic's Journal*, we find we were in error in stating that Sir John Rennie was present at the experiments.

In answer to several inquiries, we have to state that our papers on poisons will embody a history of all known poisonous preparations, including many not hitherto published.

A. GARVENS, HAMBURGH.—This information shall be sent by post.

J. HALL, MUNICH.—His letter has been received, and the matter shall not be published.

ON SURPLUS ENGINEERING LABOUR.

If there be one thing more than another that has contributed to the material wealth of England, it is the genius of her people for practical engineering; not the genius of individuals, for that may be found in France, Germany, Spain, all over the world, but the national genius for changing the forms of huge masses of matter, and setting some of them to work, to do man's drudgery by the impulsive process of nature's inorganic powers. This is as much the genius of Englishmen as it is the genius of Frenchmen to fight; and Providence has, no doubt, wisely ordered these two different propensities for useful purposes in creation. The puller down has his appointed part, as much as the builder up. The Englishmen, or the large mass of them who constitute national character, represent the force of gravitation which tends to aggregate things together. The Frenchmen, national Frenchmen who love *la gloire*, represent the force of elasticity, that tends to separate things into their original elements. The Frenchman is the steam without which there is no life in the engine; the Englishman is the boiler that economizes the steam, and prevents the life from running away in waste. The Frenchman delights in pulling down old edifices, national or political; and the Englishman sets himself to work on new structures so soon as the ground is clear. The use of the terms Saxon and Celt resolves itself into a nomenclature to express two distinct qualities in man—attraction or gravitation, and repulsion or elasticity. The former goes very much with blue eyes and fair hair, the latter with black eyes and dark hair. The Celt is the inventor, the Saxon is the worker; and it would appear that the more thoroughly the two races are incorporated, the more perfect becomes the staple of humanity. That more of this has taken place in England than in other countries, by locality and other circumstances, is the probable solution of her more rapid progress in those arts that tend to remove man from the condition of a savage. We are not Englishmen by virtue of living in England only, for the same causes at work will produce similar people in France, or Germany, or Spain, or any other country where the climate is not unfavourable; and in proportion as this incorporation shall take place, disturbing causes will cease, and mankind become a unity. This is no assumption that Englishmen are perfect, or that they are more perfect than large numbers of other Europeans, but simply a statement of the fact, that their energy goes far less into pugnacity than the energy of some other nations who have been less mixed; and, while preserving individual character, they can yet work together in unison for common objects.

A climate stimulating the desire to work, has also been an exciting cause to England's material progress. Her coal and her iron, lying side by side, near a watery highway leading to all parts of the earth, completed the cycle of circumstances whereby her mixed races of men were enabled to take the foremost place in the great work of winning a world from the wilderness; not a world for herself only, but for all humanity; and this not by purpose, for every individual thought he was working for himself, and the aggregate made laws of the most selfish kind; but with all this, they wrought for humanity with an instinct as sure as that of the bees, or ants, or beavers, in their several vocations.

How all this order grew out of savage disorder—how that "Indian-Britons grew from penguins," as Hudibras has it—how skin-dyed Britons fled before the Celts, and the mingled Celts and Romans before the Northmen, the current of manhood growing stronger with each succeeding struggle—is a world-wide tale. This island of Britain was too valuable a heritage to be held in peace by any but the strongest, and the pretender was ever worsted. Work, not war, is the world's true business; so King Arthur and his chivalry had to betake themselves to the hills and mountains, where their war horses dwindled to shelties and ponies, leaving the plains to the growers of corn and fatteners of cattle. The Lancashire song says—

> "He that gallops his horse on Blackstone Edge,
> Shall chance to catch a fall."

So, if any of King Arthur's weapon-smiths retreated there, they had to look out for more peaceable employments. Lancashire men of mark in machinery, at the outset were mostly hill men, and it might prove no waste of time to the ethnologists to trace what influence the compression of the Celtic races by the brawny Saxon had in developing latent faculties debarred from war. We know that the ancient Irish were skilled in working metals; so are the Indian races; so are the Arabs; so are the French—all skilful handicraftsmen, though in few cases have they been favourably located for progress. And even now, many of our best smiths are Welshmen. One thing seems clear, that mechanical faculties did crop out widely around our northern hills, and there probably was to be found the best mixture of races; there certainly is the cradle in which was nursed the incipient mechanism destined to overshadow the whole earth with its marvels—to rescue man from his painful drudgery, by substituting the thought of the brain for the sweat of the brow.

No one can doubt that a peculiar aptitude of mind and body existed in certain classes of men to produce these results. All men are born with some special aptitude. If their pursuits be in consonance with that aptitude, they thrive. If, by mischance for themselves and neighbours, they get misfitted to their occupations, they drag on a weary, discontented existence, a nuisance to themselves and all about them. Unhappy in themselves, they seek to pull others down to their own level, as the drunken man sought to make his sober companion lie down by him in the gutter. Want of mental culture, *i. e.*, the want of cultivation of the judgment, to enable persons to make an estimate of their own aptitude and power, at their outset in life, tends continually to add to the number of disappointed persons. Vocations are chosen by rote. A new trade or employment is sure to be supplied with picked men, if it be a process requiring skill. The picked men are few, and obtain a high scale of remuneration. The next generation sees it overloaded with a surplus number, who have "served their time to it"—though in truth, to use a vulgarism, they have "served out" their time with it—*i. e.*, utterly wasted their time in acquiring the skill to spoil materials. They find a difficulty in getting employment, and then set to work to exclude all who have not served their time; that failing to help them, they then prescribe equality of employment, that the skilled and unskilled shall all be paid alike per day, and work the same number of hours.

This sort of injustice is of very old date. It began with the institution of freemen and slaves. The freemen had the best of it, till the slaves grew too numerous, and rebelled. The barons obtained Magna Charta from King John, and kept it to themselves as long as they could. The trades' guilds obtained little charters from the barons or kings, and kept them as long as they could, suffering no one to be aggregated to them, save by apprenticeship to their "arts and mysteries," a slavery that occasionally took the form of helots broke loose, in the "Ward of Chepe," and elsewhere. The corporations maintained their charters for a long time, and monopolised member-making for the House of Commons. The trades' unions and societies of the present day are but the descendants of the old guilds, just as the worn-out fashions of Europe for the last year settles the dress of distant colonies for the existing year. Most fashions go downwards, and this fashion of monopolies, after being worn out and scouted from decent society, has taken its last refuge amongst trades' unions, seeking a monopoly of labour—the surplus and inefficient classes seeking to oust the efficient, under the pretext of chartered rights.

The immediate shape in which it is now seen is in the threatened strike of engineer workmen against engineer employers, with a view to ensure a certain rate of wages per diem for all Society men, but by no means making it sure that the employer shall get a *quid pro quo*—*i. e.*, competition shall do its work upon the employer, and the workmen shall be protected by a monopoly against all competing workmen. Pleasant, were it only durable!

By the term monopoly is understood an exclusive privilege, without any exclusive value given in return. The monopoly is demanded by the workmen under the title of the "Amalgamated Society of Engineers, Machinists, Millwrights, Smiths, and Pattern-makers," and consists in the following particulars:—

1. The abolition of over-time, except in cases of break-down.
2. When over-time is absolutely demanded, it is to be paid for at double rates.
3. The abolition of the system of piece-work.
4. The unconditional discharge of all labourers, or such class of persons at present engaged in working planing-machines or tools of a similar character, and the employment in their stead of mechanics, members of the union.*

It is clear, from this programme, that the Amalgamated Union claim to be the sole proprietors of all operations under the head of engineering.

* This clause appears to belong to the Manchester district only, so far as the confused statements can be understood.

They, and the neophytes whom they may admit, are the special caste set apart by providence to work the laws of supply and demand, and the executive committee are the hierophants.

In examining the equity of this claim, we come, first, to a definition of terms. What constitutes an engineer?

It appears that, up to the commencement of the present century, the term was chiefly applied to those whose business it was to construct and apply machines for the battering down of fortifications; but as the same men built up fortifications also, the term was used indiscriminately for either process:—

> "Oh! 'tis the sport to see the engineer
> Hoist with his own petard."

Millwright was the term used to designate the highest class of mechanical workmen, *i.e.*, men who made mills or machines to do work by wind or water power. And skilful men they were, practical geometricians, without self-acting tools to help them, needing the combined skill of brain and hand to embody their purposes. They were emphatically "masters" of their work, *i.e.*, they knew and could execute the millwork they planned more than empirically. As the demand for mills increased, and payment was high, to become a millwright was an object of ambition, and apprentices multiplied with more or less capacity. As steam-engines grew in fashion for a moving power, millwrights were the class who furnished the earliest workmen; but other workmen gradually aggregated from other employments, finding in themselves an aptitude for metal work, and the tendency of the millwrights of those days was to timber rather than metal. Gradually the term engineer was used to designate a new trade, of which metal was the staple—first in steam-engines, and then in machinery connected with them. Skilful workmen were essential, for all was handicraft. Accurate turners and borers, to produce internal and external cylinders, and accurate "chippers and filers," to produce plane surfaces, could not be dispensed with. Gradually a class of people grew up who could do these things well, but who, unlike the old millwrights, could not do other things. Division of labour grew and increased, and the engineers were quite as much inclined to keep other people out of a trade they found profitable as any of their predecessors in the guilds. Men now living will remember the "strike" at the elder Maudslay's, himself originally a workman, and the process he took to quell it, by setting on labourers and irregular hands of all kinds to use the tools of those who had turned out. Capacity was all he asked for, and "the tools to those who could handle them." How many "hammermen" became permanent "firemen" under these circumstances, or how many labourers became "chippers and filers," is not on record.

Gradually were introduced self-acting lathes, planing-machines, shaping-machines, drilling-machines, and other tools, that rendered ordinary labourers nearly as available as the most skilled workmen for all these processes to which they were applicable. They were analogous to the power-looms of the cotton factories. But it does not appear that they were regarded by the skilful "fitters" as any disadvantage to them, but, on the contrary, as a means of facilitating their work, for really skilful fitters, analogous to the old millwrights, capable of setting out and executing all those portions of work not within the scope of machines, are never in surplus, and it is natural that skilful and orderly men should prefer obedient machinery to uncertain workmen, the more especially as the machines were the most accurate, and practically increased the total demand for skilful workmen, by the greater facility of supply. Some machines were adopted for the sake of accuracy, some for the rapidity of execution, and some—as the rivetting machine—for the purpose of supplying the place of uncontrollable workmen. Every year the demand for machinery increased, and every year the demand for workmen increased; but every year, also, there was an aggregating number of inferior workmen, who could not get employment save in a glut of work—people who had unluckily betaken themselves to unfitting work—who had missed their true vocation. This difficulty is not peculiar to working engineers—it prevails in all trades and professions; many a briefless lawyer would have made a good engineer, and many an engineer thrives by quite other faculties than those of dealing with forms of matter. "The poet is born, not made;" and—not to compare small things with great—so is the mechanician. The writer once knew a man who made bad watches till he was sixty years of age, and then discovered that he had a decided genius for modelling. And one of our modern sculptors left the profession of civil engineering, after many years' practice, because he found that he had the faculty of finding likenesses of the human form in marble blocks.

Discontent with the unreal, with the untrue, is a faculty of the human mind; but the power of discovering truth is not so wide-spread as the mere perception that something is wrong. Surplus workmen, it may be supposed, are generally inferior workmen, as to capacity, or industry, or morals, for superior workmen are sure to be the first selected. It is not to be supposed that all poor people are necessarily lazy or immoral, but the majority are poor because they follow a vocation for which they have no aptitude—just as a man with a wooden leg would make a very bad digger with a spade. And it is right that they should be discontented with poverty, while they have an instinctive consciousness that there are faculties at work within them that cannot get to their development.

The surplus engineers may even be skilful men up to a certain standard, but it is certain that they are not such skilful men as those in employment; for if they were, there would be a surplus of skilled men; and, if so, the engineer workmen, as a body, would not be the best paid mechanics in Great Britain. If their skill were as abundant as the skill of ordinary labourers, their wages would come down to the same rate. The working engineers may be divided into two classes—the mechanicians whose hands work, guided by thought, and the mechanics who do all by rote, like machines. Every day will increase the absolute demand for the former—every day will decrease the comparative demand for the latter in the total amount of production.

Still, these surplus people are suffering, and it is the law of providence that no man shall be quite easy while his neighbour is uneasy. Finding themselves in surplus, they gather together to consult. It does not strike them that they are in a false position—that their half-skilled labour is perhaps better fitted for a life in the colonies; but they at once assume that there is plenty of work, were it only fairly divided amongst the whole body. There are, say, 1,000 men, and £1,500 per week of wages. Only 750 are employed at piece-work, and they earn £2 per week each. Let the whole be employed at day-work, at 30s. per week each.

Very plain arithmetic. Two hundred and fifty surplus men rendered very contented. But how with the 750, whose freedom of action has been debarred them, and whose income has been reduced 25 per cent., whose power of accumulation for a rise in the world has been violently taken away? And how with the employer, who has been arbitrarily deprived of the power (piece-work) of knowing beforehand what his work will cost him, and whose customers, lacking this information, will curtail their orders? And, lastly, how with the great mass of the public and the foreign nations?—all whose supplies are to be interfered with for the benefit of the surplus engineers.

And then, supposing it could go on, and there existed not a surplus, still the workmen would bring up their children to this comfortable certain trade of thirty shillings per week. How should we provide for this new surplus? Get rid of the machines, or at least drive the labourers from them! Then comes an agitation on the part of the labourers, and we get only to the same conclusion as before. What shall we do with our surplus? Must all society be disturbed for ever because a surplus is uneasy? It is a question of deep import. If the engineers have a right to make an equal division of the joint profits of skilled and unkilled, so has every other trade; and, by the same rule, badly paid trades have a right to make joint-stock with the well-paid trades. How long could this last? Where would be the security for "the fair day's work for the fair day's wage?"—where the profit of the capitalist?—where the maintenance of the labour fund?—where the stimulus to the individual energy that alone constitutes national savings, the difference between annual income and annual expenditure, the material foundation of all national greatness?

Little perception is required to foretell the result. Our commerce would leave us: our most skilful and intelligent workmen would leave us for lands where they might be paid, even after the dictum of St. Simon—"according to their capacity and their works." England would become one huge den of pauperism, and a prey once more to the strong men of the North, who would sweep down on her as exterminators, and after a century of warfare begin a new nation. There are hundreds of thousands of clear-headed and intelligent workmen in England, who still mean to remain a nation, and their sons and son's sons after them, and who will say to the complaining surplus, "We will maintain you as paupers, or pay for your passages to the colonies, where work is in surplus; but we will not forego the energy of manhood, we will not sink ourselves into serfage, because you happen to have mistaken your vocations, and lack the courage to correct your error." "We are working at the great work that shall ultimately rescue all mankind from drudgery, and cannot be impeded by individual obstacles." "You suffer, but suffering is the law of ignorance. There is work for you in the world, but you must not interrupt the actual workers in the process of finding it out."

In examining the great factures, not *manu*factures, of England, the great division is into home and foreign consumption. The home consumption will always go on increasing as prosperity increases, and there is little likelihood that other nations will supply us cheaper than we

can do ourselves, unless in cases where the raw material constitutes nearly all the value. In factures for foreign consumption, great changes must take place. We invented and made machines to produce clothing of cotton, and flax, and wool, and silk; and, as a consequence, we supplied ourselves and many other nations with clothing. But in many cases this has been only because some of the nations had not obtained instruction in their own development. Possessing the same machines, there is no reason why cotton, flax, wool, and silk, should not be manufactured in the countries where they are respectively produced, if there be a demand for them. Negro fingers can attend machines to produce cotton clothing on the Mississippi or Missouri as well as New England fingers in Boston, or English or Irish fingers in Manchester. Australian wool can be as well wrought in Sydney as in Leeds, if population be equal. Flax may be turned to account in manufactures as well in Belgium or Ireland as in England; and it is a tolerably well ascertained fact, that the long delicate "psychical" fingers of the Celtic races are better adapted for fine textile fabrics than the coarse hands of Saxon peasants, or other people of brawny muscles. The artificially warmed atmosphere of textile mills—not necessarily an unhealthy atmosphere—resemble the climates indigenous to the delicately formed races of men, and are not fitted for the rude tamers of rough nature—the ploughman, the seaman, the quarryman, and the navvy. It is clear as any demonstration in arithmetic, that the cotton trade must ultimately depart from us, save for our own uses, as fast as the cotton-growing nations grow up to maturity, unless we can maintain a population numerically superior and at lower wages, to undersell them—a thing never worth doing, because it is fostering an inferior staple of humanity, and the object of all morals is to have a happy population rather than a mere numerous one—a strong, healthy, vigorous, and intelligent population, each mature individual capable of self-protection by forethought, and not dependent on the care and protection of others, like children.

Such factures as have come to us by simple default of other nations whose pupilage we have tended, till we have taught them to go alone, we must ultimately give up. There is a selfish view of this subject, now growing out of date, viz., the plausible attempt to keep them for ever in pupilage and what is called dependent on us for the supply of their wants, by keeping all machinery to ourselves, and discouraging all attempts at progress in others. This ignorant spirit prompted the crushing of the wool manufacture in Ireland. This spirit prompted the laws forbidding the export of machinery. The laws crushed Irish manufactures, and bore their own punishment with them, by promoting the growth of paupers, who overwhelmed us. But no laws could prevent the export of drawings of machines, or of the brains to make these drawings; though for a long time skilled workmen were actually by law a kind of *adscripti glibæ*, and not permitted to leave the country without an order in council. The eternal laws of human progress could not be impeded by these childlike doings. The nations of the earth grew up to the capacity to use machines, with which our engineers supplied them.

The next step in progress in the engineering of clothing, will be the production of machines that, instead of flat webs of cloth, will produce completed garments. "They parted my raiment amongst them, and for my vesture they did cast lots." "The coat was without seam, woven from the top throughout."

And what will become of our sempsters, if the handicraft of olden Judea comes to be the type of the machine factories of the latter time? Why, already the "sewing machines" are giving notice that the ensuing age will not need human stitchers, and they will gradually disappear. Where are now the old copyists of books, antecedent to the early printers? The men of the coming age will get another step from drudgery, leaving another record for the past; the engineers will have added another branch to their art.

There are many arts that have yet to undergo this change—many classes of workmen that will have to disappear—not as men, but as workmen, at processes no longer needed. Where are now the hand-loom weavers? Gone! And where are now the men without shirts? Gone also! The few suffer, the many gain. And where will be the builders of wooden ships in the next score of years? If not gone also, a scanty number complaining of their hard fate from the perverse preference for iron!

Our destiny is before us. For a century to come we shall be the choice makers of machines for all the earth, from the domestic, steam, or other engines—the cooks' and domestic servants' drudges, that are to be universal—the mills that cut and mould material and prepare our food and clothing, the farm machinery, of which, as yet, we have but faint gilmpses, the iron steeds of the rail, up to the iron surface-fishes of the ocean, that will mock the fury of the storm, and brush away the angry cachalot in his swift career of vengeance. We see as yet but the beginning of ocean locomotion. We wait for the chemists, who are in arrear of travelling mechanism, even as they are in advance of the mechanism of food cultivation. We wait for the power which is yet to supersede our long and faithful servant, steam. In casting away timber, the ship-material of our youth, provided by nature for one period of our progress, a material which limited us to size, we enter upon the uses of iron, the limit of whose proportions we as yet know not. Many of its details we have worked out. We can hermetically coat it, and stop rust. We can rivet it into air-tight cells, and forbid it to sink. We can defy fire penetrating beyond the limits we assign to it. We can make icy caverns in its cells, and maintain polar cold; and we can keep up blast furnaces in its entrails, to serve as lungs, to confer on it life and power of locomotion. But as yet we have not got to our limits in form, proportion, and size. Our iron forges are as yet toys, and must change their location. The dwarfish workshop of the hills must give place to the giants of the ocean border, for the proportions needed are no longer capable of land transit. As the whale is to the race-horse, so is the ocean steamer to the land locomotive. It is size that gives speed on the water, that makes the hugest of the sea waves seem but as ripples of the pond; and to obtain great size in the ship, it is essential that the parts composing it be of great size also—that the iron ribs and iron planking be proportional to the whole. Pigs of iron may be transported in any number from the mine to the water-side, and may there be aggregated to the requisite form and proportion, at the smallest expenditure of fuel and labour. The heat that makes the iron malleable may help to forge it to its shape—may help to fit it into the structure of which it is to form a part. The fewer the number of pieces in the vessel, the stronger it would be. Could the vessel be soundly forged in one mass, without joint or seam, it would be still better, and all that approximates to this is a gain. Till the tools and machinery for these purposes shall be erected at the water's edge, we cannot construct the vessels we need thoroughly to master the ocean and tame it to the purposes of man, to make it a smooth highway whereon men may travel as safely and as commodiously as on land. For if we can attain the size to smooth the waves of the ocean, we are sure of corresponding increased speed and the absence of sickness—we can be safe from fire, safe from wreck, safe from famine and the tortures of thirst.

These are to be the work of England through coming generations, each year adding to the knowledge and experience of the last. In these works, till her coal and iron shall be worked out, will she keep the lead of the world; machine after machine, self-acting, diminishing drudgery, and adding to the total numbers of the skilled workmen, the great engineering race, the pioneers of the future time, when men shall truly have won the world from the wilderness, and surplus humanity—that surplus which ignorance only induces—shall have ceased to exist.

What are the proximate means? Plain to all who seek them with a will to discover. They are summed up in one word: *Education!* Not that kind of education that begins and ends with the mere possession of the tools of knowledge—reading and writing. As well might we give a boy a basket of tools and bid him be a carpenter. The true use of the tools must be imparted, as well as the tools themselves. The judgment must be cultivated, to enable boys—incipient men—to discover their own natural aptitudes. In schools—deserving of the name—it were possible, by fourteen years of age, so to cultivate the physical and mental aptitudes of boys that they should be familiar with every kind of tool, and uses of tools, that would form the staple of their bread-winning at full age. At the time of leaving school they might all know the general round of industrial operations, and each would be attracted to his peculiar aptitude as surely as iron to the magnet. They would not go forth into the working world with the risk of misfitting themselves to their operations. They would not be doomed to profitless work, and to pass great portions of their time in envying and impeding others.

It may be said, that this may be well for the future, but how will it help the existing surplus, who, whether by their own fault or by that of their teachers, are now lacking employment? How will it help the engineers, who propose to strike because they are not provided with regular work?

Clearly they are God's creatures as much as their more fortunate brethren, and even were their employers successful in proving against them still greater injustice than they are accused of, still they are on the earth and are entitled to a mainteuance from the fruits thereof, either from the general community, or from the members of their special trade. But this maintenance must not be collected by any process diminishing the earning power of the members in work—must not be collected by any injustice to individual humanity, or it will be an accursed maintenance—bread bitter in the mouth, and not yielding wholesome nourishment.

What per centage is there of surplus numbers in the engineering trade? How shall we get at this, to enable us to deal with the diffi-

culty? There be some few employers whom this question does not trouble, or who fancy, in their shortsightedness, that this will give them a power of oppression, and make the workmen subservient. There be employers of this kind who regard their men only as a kind of machine, more apt to get out of order than their other machines—who care nothing for them, save when work presses, and would work them to death, as a planter did his negroes, or a postmaster his horses, when the maxim prevailed, "better buy than breed." Employers who, centuries back, would have been reiver barons, and would have levied black mail, squeezing serfs and travellers as they would now squeeze workmen—if they could. Employers who, thirty years back, would have cut down rebellious workmen at Manchester, and would, under the then existing law, have incarcerated them for two years in prison for the crime of compassing their own expatriation to work in foreign lands for larger pay. Employers who, at Darlaston—so runs recorded evidence—would keep tender children at work as apprentices, and feed them for cheapness on putrid fish. Employers of this type, hard of heart and coarse of nature, "word-and-blow men, and the blow first," still exist, but they are few in number, and dare not execute their coarse thoughts.

When we think that only thirty years back, these monstrous oppressions were practised on working-men, and there still be those who would perpetuate them if they could, let us not marvel that the escaped slaves should indulge in an oscillating process of injustice, driving upwards the wave which had first rolled on them from above. Let us rather rejoice over the saturnalia of drunken freemen, knowing that they will return to order when the paroxysm shall be expended.

But to return: What is the real surplus number in the engineering trade? We cannot get at this at present. Judging from the published demands of the Executive Committee, they are considerable; but it is alleged that these demands are merely a cover to raise the rate of wages. If this be so, if all the workmen approve it, very ignorant must the workmen be. Their policy is akin to that of the ostrich, who buries his head in the sand and dreams he is not seen. If it be not so, but merely a contrivance of a few to better their own position at the expense of the many, it behoves the many to speak out and stay the reaction of the employers, who, under a system of coercion, not better than that of "stand and deliver," are to be enforced to pay black mail in succession, while the few exact contributions from the many to levy this one for their own benefit. Economically considered, it would be far better for the many simply to maintain the few in idleness.

But the employers will not submit to this. They threaten to gather together, and reduce the whole body of workmen to a state of pauperism, by stopping work, and laying an embargo on the wages fund. Sharp and short will be the result. The men must either return to their work on the employers' terms when victorious, or the employers will bring in strangers in sufficient numbers permanently to decrease the rate of wages. And a powerful stimulus will be given to the production of new and improved labour-saving machines, all tending to the general benefit of the community, but with immediate disadvantage to the workmen, who are endeavouring to circumvent natural cause and effect. There is a possibility of a small number of dissatisfied men—dissatisfied either with or without reason—coercing the great majority by processes of deception. £25,000—half a million of shillings—comprise the weekly contributions of 10,000 men for nearly twelve months, and show a considerable influence of fear or affection. There is no proof positive either of the one or the other. Men earning 50s. per week may be glad to pay 1s. black mail for the sake of a quiet life. One hundred agitators, lying profusely, and with means at command, might, taking one at a time, coerce 100,000 out of 1s. each, under pretext of keeping away a wolf, and persuading each single individual that they, the 100, were really 100,000—and, who could tell, in darkness, in ignorance? One thing is quite clear, that the great mass of workmen have an indistinct notion that employers are their natural enemies. There is also another thing clear, that employers think that the workmen are grossly misled by a body of professional agitators, who live on their earnings.

There may be some truth on both sides. Habitual justice to workmen, on the part of employers, is not of so old a date as to have extinguished the instinctive memory of injustice. The "United Irishman," when he obtained citizenship in the American Union, and was puzzled which candidate to vote for, exclaimed, "Agin' the Government, anyhow!" thinking he could not well be wrong in that choice. It is for the employers to break down this prejudice by the constant practice of justice, and by the promotion of institutions beneficial to their workmen, growing out of the conviction that mere money-wages is not the whole duty of man—of employer to workmen. And it is for the workmen to show that, if they err in ignorance, they still err voluntarily, and are not tools in the hands of designing men, who play them as puppets for their own purposes. No better method of doing this could be found than by printing lists of the whole workmen engaged in a trade, precisely as their employers' names are printed in the Directory. Worse uses than this might be found for a portion of the £25,000 subscribed. This done, it would be at all times a practicable thing to ascertain, by numbers, the views of the whole body; and it would not be practicable to coerce a majority by a minority. It would, moreover, insure an executive council really representing the opinions of the majority. We should then know if it be a possible thing for so large a body of intelligent men to be really in favour of day labour in opposition to piece-work—of monotonous serfage in opposition to individual energy.

Since the above was written, the aspect has become much clearer. The Society disclaim many things imputed to them by the employers, and probably there will be no strike. What is needed is a thoroughly good understanding between employers and workmen, whose interests are really one and indivisible. Justice, unswerving justice, genial withal, and recognising all men as integral portions of humanity, must be the universally-recognised principle of action. And, even supposing that the workmen were all wrong in this dispute, let it be remembered that, only by outcry and discussion, is there any chance of their being set right. Better, far better, is it that the workmen should be free men, with wrongheadedness to correct, than unenergetic slaves of mere blind obedience. Out of energy, wisely guided, comes national greatness. Lacking energy, all progress ceases. Let not the employers deem they have gained a victory, unless the *minds* of the workmen be convinced. The victory, if victory it be, gained only by a threat of starvation, is but another name for coercion; and no manufacturing profits can come out of involuntary labour. There is, doubtless, some groundwork of injustice that has found an inadequate mode of expression in the propositions of the Amalgamated Society. They think that these propositions will be a remedy for evils inflicted on workmen by such employers as, lacking genial feeling, would extract a hard competition profit out of "the lives of men"—selling their own souls and their workmen's bodies without useful result. There be men of this kind, who would work up the whole raw material of England into a useless commodity, by the expenditure of the last muscle of her workmen, and throw the result into the sea, if by so doing they could realise a per centage on the transaction to carry with them to other lands.

It cannot be denied that, in the hands of such people, and with a supply of surplus labour, piece-work may be a machine to reduce wages to an unhealthy minimum. A man may be set to work at a given price, and, month after month, the price may be reduced till the merest pittance be left. But the fault is not in the piece-work—it is in the competition of the workmen with each other. The piece-work is simply a mode of measuring the capacity of men with each other, and remunerating them according to their capacities. This is only a question of proportion, totally distinct from the question of high or low wages, which depends wholly on the proportion of numbers to the demand. Whether the employer pays 6d. per hour, or 6d. per dozen, on an article representing an hour's work, is the same thing. But piece-work is the only mode for an employer to ascertain what his work is to cost him, or to insure his obtaining from the workmen the "fair day's work for the fair day's wage." At day wages, if a man be devoid of conscience, he will do as little as he can; and, on the other hand, the conscientious man will do more than his share, which will go to the account of his idle fellow. That is not justice.

With regard to over-time, if it be a contrivance to enable a workman to make up a bare living which his regular time will not yield, it is simply an indication that a surplus amount of workmen enables an employer to dictate his own terms, and make a competition profit out of their stinted wages. This is neither more nor less than the practice of cheap shirt-makers, and cheap machine-makers do the same thing. A most painful thing must this be to any humane employer—painful to any wise employer—for, provided work be plentiful, men at high wages yield the most profit.

What does over-time really mean? Time beyond the average number of hours which men can work without injuring their health. Therefore, a certain number of hours are conventionally called a day's work. But, to some men, these hours may be really over-time, being too much for their strength. To others, again, they may be under-time, from their greater capacity. Convenience in a factory settles an average; but to dictate to those with superabundant strength the number of hours they shall work—to deprive them of their right to dispose of their own time—is a gross injustice. It is making individuals slaves for the benefit of others.

It is clearly not desirable that workmen should rise up to work till they go to bed to sleep. This would be to treat them as the beasts that perish. Some portion of their time ought to be set apart for the cultivation of their minds; and all wise employers would seek to bring this

about, were it only for their own pecuniary interests. Mr Ashworth declared that "he considered his trained workmen to be equivalent to £10,000 capital." An employer's workmen are, in truth, his business family, and he can no more neglect them than he can his children, without suffering for it.

The claim of double payment in cases of break-down indicates a great want of brotherhood between, not only employers and men, but workmen and fellow-workmen. A break-down is equivalent to a fire or a leak in a ship—all are sufferers. The break-down throws men out of work. Is it right, at such times, to make a selfish extra profit? This almost looks akin to the practices of salvage men, or wreckers, making a profit of distress. The brave men who help others in shipwreck do not reason thus.

With regard to the proposition to allow only mechanics to work at labour-saving machines, what is such labour but mechanical labour? and is not that the direct converse of the labour of the mechanician or skilful man? Machine labour is labour reduced to less than the skill of a ploughman—to that of the turner-round of a crank-handle, or similar work—a labourer at a crane. There would be as much justice in prohibiting the machine itself as in prohibiting a labourer from working it.

It would be great advantage to the community and to the purchasers of machinery, and also to employers and working engineers, if more forethought could be given to the probabilities of demand; could orders be given out twelve months before they would be required, they would be executed more cheaply, and the alternation of glut and scarcity, so mischievous to all, would be avoided.

Meanwhile, all right-minded men will deprecate and resist injustice or tyranny on the part of either employers or workmen, in the full hope and belief that their misunderstandings can be but temporary, and that the time is coming when the welfare of the working-man will be synonymous with the welfare of the whole community.

Since this was written, the ocean slaughter of the "Amazon" has been enacted. Useless is it to inquire into the detail. The one broad truth is before us. *She was burnt because she was built of combustible materials.* We possess the specific knowledge how to construct vessels *absolutely safe*—more safe than any land locomotive—vessels not needing insurance; and whoever henceforth builds a wooden steamer for ocean navigation, involving continuous heat for days, will lay a pitfall for human life. A wooden vessel, dried to tinder by large internal fires, is as perilous as a powder magazine, and should be so understood by all those who "go down to the sea in ships."

W. Bridges Adams.

ON POISONS, THEIR PROPERTIES, EFFECTS, DETECTION, AND ANTIDOTES.

II.

On swallowing arsenic, the symptoms of poisoning are usually developed in about an hour—involving sickness, pain, and heat in the region of the stomach—followed by vomiting, thirst, and dryness of the mouth and throat. The ejected matters are green, yellow, or bloody—the pulse being frequently small and irregular—with oppressive breathing, cold extremities, cramp, and convulsions. From three to five grains of arsenious acid, if sufficiently dissolved, is enough to destroy life. Various modes of treatment are adopted in cases of poisoning by arsenic, the stomach-pump being the most satisfactory application; in default of obtaining which, in the hour of need, the next best remedy is, the exciting of vomiting by means of emetics, such as sulphate of zinc, sulphate of copper, or ipecacuanha, encouraged by large draughts of new milk, linseed tea, or gruel. The best known antidote is, the hydrated tri-oxide of iron; but recently another one, apparently very good, has been added to the list. If this is really efficacious, it will be a most valuable remedy, as it may be obtained in any chemist or grocer's shop. It is calcined magnesia; but according to the existing state of our information on the subject of the theory of the combinations of magnesia and arsenic, it would appear that a high degree of calcination would be objectionable, and that the ordinary magnesia of the shops may be used. Purified animal charcoal has also been recommended as an antidote, but little reliance is to be placed upon it, as its action is somewhat doubtful. Whatever antidote is used, it is essentially necessary that one or other of the substances we have mentioned, should first be given in solution, the stomach-pump being afterwards employed to evacuate the stomach, and bring away the mixture contained in it. If a stomach-pump is not at hand, an emetic must supply its place—repeated applications being necessary, if it is thought that the whole of the arsenic is not combined with the antidote. In the case of the use of hydrated tri-oxide of iron, a dose thirty times greater than the amount of the poison is necessary to produce the proper effect. Bi-chloride of mercury—or, as it is generally termed corrosive sublimate—has been employed in connection with arsenic, by many of the great historical poisoners. In 1613, the Count and Countess of Somerset gave it to Sir Thomas Overbury, and the notorious Locusta poisoned Britannicus and Claudius with substances evidently appertaining to the mineral kingdom. From the convulsions of Britannicus, it has been concluded that his poison was really the bi-chloride of mercury, whilst the appearance of the intestines of Claudius gave indications of arsenic.

From the intimate knowledge of poisons possessed by the Borgias, we all know how fearful a celebrity is attached to the 15th century. Amongst the agents used by them for the satisfaction of their cupidity and blood-thirsty vengeance, was cantharides, and a white powder, supposed to have been arsenious acid, or perhaps a mixture of arsenic and corrosive sublimate. It is alleged by some authorities, that they prepared their drug by the abominably cruel process of giving a large quantity of arsenic to a bullock, and suspending the animal by the hind legs from a beam, the saliva or fluid flowing from his mouth amidst his convulsive writhings, being collected and preserved for the purpose of poisoning. By this mode of preparation the arsenic was rendered more soluble, and left no sediment in the bottom of the sparkling goblet by which it was administered, of sufficient importance to arouse suspicion. It is by no means improbable that this is an exaggerated account of the diabolical proceedings of these notorious poisoners, for it savours strongly of the romantic; but it is certain that, whatever process was used, an excessively deleterious compound was most lavishly employed by the Borgias for the destruction of human life;—their crimes will ever leave a dark stain upon their high-born name.

Taffano, an Italian female, also invented and used a poison to an enormous extent. By the use of it, according to her own statement, she destroyed not fewer than 600 persons. The compound, which was called L'Agna Taffano, after its inventor, was most likely a mixture of arsenic and potass.

In 1672, the Marquis de Brinvilliers poisoned a number of persons in France with a mixture of arsenic and corrosive sublimate; and some years later, various transactions of a similar nature were perpetrated by a woman named Lavoisin, by means of the drug so well used by the Marquis de Brinvilliers, and at that time called, in jocular phrase, the "powder of succession." Such, however, was the ignorance of the age in which these cases occurred, that the officials appointed to examine into them, condemned the woman in this instance, not as being a poisoner, but a witch. Before quitting the consideration of the poison arsenic, it may be remarked that this poison is frequently very difficult of detection, and this difficulty arises chiefly from the following causes:—In the first place, it is a poison of which a large portion is frequently rejected, and the minute portion actually left in the body renders it a matter of much greater nicety of analyzation; second, it is susceptible of being carried through the whole system by the current of circulation, so that a quantity of it becomes fixed; and, third, it possesses a localizing power, taking place principally in the liver. This organ has seldom been made the subject of investigation; and even if it had, it is not likely that arsenic would often have been found there, from the fact that the ordinary means of boiling the flesh with acidulated water has not always the effect of extracting the arsenic, as some of the organic matters of which the body is constituted, form with it compounds insoluble in acidulated water. The best method is, therefore, to boil the flesh gently in sulphuric acid until the whole is dry, afterwards mixing it with a little nitric acid. This mixture, when heated, causes the destruction of the whole of the organic matter, and also transforms the arsenious acid into arsenic acid, which is more soluble. The residue is afterwards transferred to Marsh's test-apparatus, and there tested in the manner described in our earlier article on this subject.* It is chiefly due to the facts which we have described that chemists have obtained such varied results, leading to so many different conclusions, notwithstanding the rapid progress of modern toxicology.

Madame Laffarge was condemned for poisoning her husband, yet the chemists that first examined the body of M. Laffarge could find no arsenic, whilst their successors detected enough, in their opinion, to destroy life. The particulars of this case must be fresh in the recollection of our readers, so that we need not here detail it; but of this it is certain, that every philanthropic mind must deplore that this highly accomplished lady was shut up in a dungeon, when such very opposite decisions were given by the eminent men who conducted the analysis, and more especially so, when we consider that no other crime had been laid to her charge. The preparations of mercury are exceedingly poisonous: such as the nitrate oxide, or red precipitate; bi-sulphuret, vermillion; and bi-chloride, corrosive sublimate,—the last of which we have

* See page 74, *ante*.

already mentioned as having been extensively employed for poisoning, and the instructions given under the head of arsenic are equally applicable for examinations relative to it. The salts of mercury are all decomposed or volatilized by ignition. The suspected fluid is put into a glass-tube, sealed at one end, and mixed with a little potass and charcoal, and heat being applied to the tube, the bi-chloride of mercury rises in fumes, and condenses in the form of a white crust on the sides of the glass. This crust is then dissolved in water, and subjected to the following tests:—Lime-water, which gives a precipitate of an orange-yellow colour; a solution of sub-carbonate of potass, which produces a white precipitate, and, on further addition, an orange colour; liquid sulphuretted hydrogen, which throws down a dark-coloured precipitate; and this precipitate being dried and subjected to a strong heat in a glass tube, it volatilizes without any odour of garlic, thus distinguishing it from arsenic; ammonia, which produces a white precipitate; and nitrate of tin, a copious dark brown; proto-chloride of tin, a dense white precipitate; and nitrate of silver, a crude precipitate, characteristic of hydro-chloric acid; and albumen dissolved in water, a white flocculent one. A few drops of the bi-chloride of mercury being placed upon a bit of gold, and touched with an iron pin, a silvery amalgam is formed at the point of contact, owing to the excitement of a galvanic current; a solution of hydro-iodide of potassium is also a very characteristic test for the bi-chloride, it forms a dense yellow precipitate, changing to a bright vermillion red, which is the iodide of mercury; caustic potass gives a yellow precipitate, but if the solution be very diluted, a white cloud only appears.

The best antidote for the bi-chloride of mercury is albumen, which converts the poison into the sub-chloride. In administering it, the white of egg is to be dissolved in water, one being given every three or four minutes to decompose the bi-chloride, so as to lessen its virulence, and excite vomiting. The drink of the patient should be milk, gum-water, sugar and water, linseed-tea, or water itself at the temperature of 80°. Gluten from wheaten flour decomposes corrosive sublimate; when used it is to be mixed with water. Moist per-sulphuret of iron and liquid sulphuretted hydrogen, employed along with emetics, have also been recommended; but, from the very conclusive experiments of M. Orfila, albumen is most to be relied on. Dogs which had taken 10 or 12 grains of the bi-chloride, died in violent convulsions in the space of two hours, but those treated with white of egg soon recovered after vomiting. When bi-chloride was digested with albumen for some time, it was given in considerable doses without producing the slightest effect.

R. Smith.

MESSRS. FAIRBAIRN'S EXHIBITION TANK LOCOMOTIVE.

(Illustrated by Plate 89.)

We this month present a longitudinal section of this locomotive, as shown in the Great Exhibition. It will be remembered by visitors to the railway department there, as a specimen of good work without any pretensions to finish. We shall furnish an additional plate and details of the mechanism next month, and then submit it to critical examination.

DISCOVERY AND INVENTION.

IV.

After what has already cursorily dropped from us, somewhat will have been anticipated of that which we may say with regard to *time* in discovery and invention. In the general reading of the world, we do not sufficiently bring down into our own bosom that learning which may be said by this means to become more emphatically our own. Man, and what he has done, may, in this respect, be considered but as a great telescope, or microscope, through which the individual eye may define, with greater precision, the form and motion of the individual self. That self is greater than the great instrument of the outer world can be, simply because that, without it, such outer world, to such individual, would absolutely cease to be. Dugald Stewart, not following the ordinary current of thought, said *—Discovery was the birth of time, not of genius; and the more lengthened thought—the deeper reflection—we bring to bear upon the subject, the more truthful and significant does this proposition appear. Discoveries and inventions are moral revolutions. Some are felt to be coming silently and grandly marching towards us like the morning light; others are seen bursting out suddenly in magnificently attractive array. In chemistry of the present day we have an instance of the former; and, as an instance of the latter, we may refer to the mode in which the recent discovery of the planet Neptune was effected. Some commanding power in nature seems to act, and not man's skill. And although, in the two cases we have here adduced, it may not be possible to give a reason why things should have been brought about as they have been, yet is it left us not obscurely to trace the paths which have led the scientific mind to its goal. But who in the grand discovery which characterised the fifteenth century does not now see the main foundation of that successful struggle for mental freedom which, in the sixteenth century, was attempted to be strangled by the unauthorized and unhallowed power of an indulged and arrogant papacy? Ripe, the fruit falls; knowing its value, man's genius would rather patiently wait for the falling. Care and cultivation is different from forcing; and those who know best tell us that the hothouse mars as well as makes. This very discovery of printing may, to some extent, be said to have been immature; for many circumstances concurred to prevent its general spread until the successive thoughts of Luther, Bacon, Harvey, Galileo, Locke, Newton, and others, claimed and shared in greater and greater extent its noble and imperishable prerogatives. Our faculties of discovery, says the yet illustrious metaphysician above named, are suited to our state,† and our state, progressed more in one direction than in another, accounts for our being happier in our researches and inquiries than at other times. To this fact may be ascribed what are called rediscoveries. The "state" of Faust, or Koster, or Schœffer, or Guttemberg, or whatever German it was who invented printing four hundred years ago, was, in our faith, of precisely the same power as of that person who may have made the discovery in the East two thousand years ago. The "state" of Prometheus and of Franklin would, in like manner, be at one, with advantage rather to the latter. The only difference in the cases was, that in the earlier time the fact was to the utmost appreciated, where that "utmost" was surrounded with circumstances of less power. Watt had just been studying the laws of evaporization, when, in the nick of time, a model steam-engine was sent to him to repair; and one consequence has been, that on this very day we have ourselves travelled, with no sort of inconvenience whatever, two hundred miles in rather more than as many minutes. We may catch ourselves, as people often do, wondering how this or that great though simple thing had not been found out long before. But presently, if we are able to analyse our wonder aright, we see that it could not have been, or that if it had, it had been of no use. We may, in some degree, test in ourselves this character of discovery and invention being full grown children at birth. Having ascertained and placed ourselves in such a position as thoroughly to understand the status of the subject matter, and becoming compelled to observe the apparently inconsistent theories which have been attempted to give life to that status, we may, by reflecting, be led to some hypothesis by which the inconsistencies may be better explained. Happily the discovery may involve the necessity of inventing new instruments of discovery—new modes of action, of power mechanical and mathematical. We may discover such instruments, and not resting there, go on, still standing successively above all previous attainments, until old appearances are reconciled with new truth. Fortunately great minds have not stuck at difficulties, and conquest of one has led to the conquest of another. So Newton, by means of his invention of the infinitesimal calculus, became enabled more readily to prove his law of gravitation; so Laplace, by his still higher analysis, resolved the problem of the libration of the moon. The early ages were ignorant of that knowledge which is ours, and which teaches us, more and more plainly as we attend to its instruction, that the individual, society, and the world, all *stand ready* for every new discovery and invention.

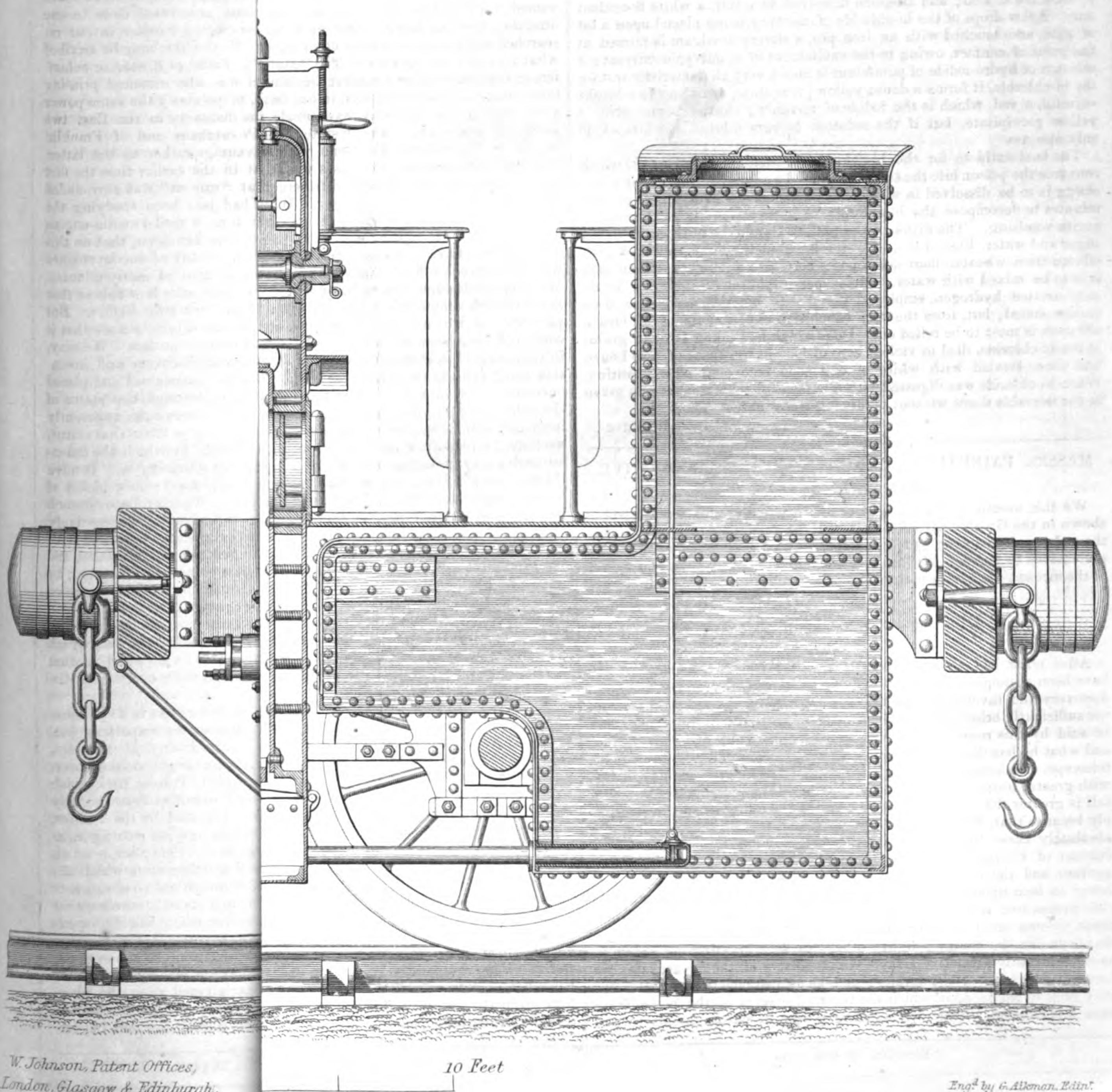
From what we have said above, it follows that *place* has to do in these matters as well as *time*. In order to make discoveries respecting elephants, we should not, except it might be for palæontological purposes, travel to the poles, nor should we go to the tropical seas to make observations on the spermaceti whale. To trap the elk in Poland, the ostrich in Africa, or the buffalo in North America, we can alone successfully use in those respective countries the method invented by the hunter, viz., dressing in the skin of one of the animals, and so getting near enough to the prey to secure it by the ready shot. This place is as an outward status to the status towards discovery and invention which the individual stands in. And it is as absurd, although not so obvious, to expect to discover or invent where the individual status towards either is inadequate, as it is to seek to invent or discover where the indispensable means do not exist. We owe, probably, to some law of biology, not yet made plain, the gradual extension of such like means over the world. Few, comparatively, though many, may the examples be; but wherever objects of any description are disseminated from the place they originally occupied, there such examples exist. To this speculation it is, we conceive, a point of the very deepest significance and import-

* Ency. Brit. 1st Diss. p. 218.

† On Human Understanding, b. 2, c. 23, § 12.

Plate 89.

Vol. IV.



10 Feet

W. Johnson, Patent Offices,
London, Glasgow & Edinburgh.

Engd by G. Aikman. Edinr.

ance, that we can trace in the concurrent history of all nature, including human annals, the local annihilation of several species of the animal kingdom, and the cosmopolitan character which is becoming attached to the works and ways of man.

The foregoing observations appear naturally to lead us to a very curious subject—we mean that which we may call *co-ordinate discovery and invention.* Two persons living near the same or at a different place, near the same or at a different time, it may be hundreds of miles, or hundreds of years between, hit, by some means or another, upon the same thought, and introduce it into the world to live for ages, happily never to die. "Very curious!" "very singular!" are exclamations stereotyped upon the tongue; and the smile, while we may utter them, is too seldom accompanied with due reflection on what, upon such reflection, must appear miraculous, in the sense of most wonderful.

Perhaps in ascribing the invention of the art of printing to one particular person in Germany, we may, indeed, not be justified by historic truth. Baron Humboldt considers it probable that the invention was made "simultaneously," and quite independently, by Guttemberg, in Strasburg or Mayence, and by Lorentz Jannson Koster, in Hærlem, between 1436 and 1439.* If we admit this, the matter must further increase our wonder when almost universal opinion seems to bestow upon China the honour of the first invention. China has also been considered as having anticipated the great geometrical discovery of Pythagoras, as well as the important one of the loadstone. The child Pascal had, one by one, demonstrated to himself the truths of the thirty-one first propositions of the 1st Book of Euclid, when his father accidentally discovered him solving the thirty-second. The arithmetical machine, which he afterwards invented, was proved by Dr. Hutton to have been invented many years before by Cardan, Stifelius, and even some others. On the 29th of December, 1609, Simon Marius, at Ausbach, and, on the 7th of January, 1610, Galileo, at Padua, independently discovered a satellite of Jupiter. The laws relating to the collision of bodies remained unknown until the Royal Society of London recommended the subject to the attention of the fellows. Three papers appeared, in which those laws were all correctly laid down, although no one of the authors had any knowledge of the conclusions obtained by the other two. We are told that the first of these was read to the Society in November, 1668, by Dr. Wallis of Oxford, the next by Sir Christopher Wren in the month following, and the third by Huygens in January, 1669.† It has repeatedly happened to self-taught men, that they have made many discoveries which had been made before; and this, by the way, affords some clue to the real nature of education, which, in all its phases, is the means of preventing the loss of power. A remarkable coincidence in discovery recently took place with regard to the eighth satellite of the planet Saturn, which was added to our knowledge in September, 1848, in England and America, by Mr. Lassell and Mr. Bond; and this occurrence was still more remarkable from the fact of the similarity of the very process of thought in these gentlemen immediately previous to the discovery. A more astounding instance—more astounding because the very ancient method of discovery was forsaken, and a new one adopted —is in every one's memory, namely, that which very lately blazed forth in France and in England, when Leverrier in the former, and Adams in the latter, rising from their mathematical calculations, bade the observing astronomer point to a particular quarter of the sky, and behold, for the first time, the new and far distant planet Neptune. We could dwell, but we must not dwell long, on this unparalleled circumstance, which we purposely associate with others of comparative insignificance, in order that our reader may have the facts presented to his mind in the heterogeneous order in which they were observed by us.

Again, it is recorded that the apparatus of Dalibard for trying the experiment as to whether lightning was a form of electricity, was tried on the 10th of May, 1752, in the neighbourhood of Paris, where sparks were drawn from the rod, and an electric jar charged with electricity. On the 15th of June, in the same year, Franklin, near Philadelphia, also obtained sparks by means of his kite.‡ No doubt the comprehensive genius of this American philosopher had enabled him previously to invent the theory involved in the conditions of the Leyden jar; although, before him, Dufay had shown that the electrical machine draws its supply from the ground, and Watson had advanced a step further, in assuming that every substance, naturally, holds a certain share of the fluid, which, in a charged jar, is redundant on the one side and deficient on the other. Dr. Whewell, in his "History of the Inductive Sciences,"‖ reminds us of the discovery of what, until the last few months, has been considered the composition of water, by the union of two gases, oxygen and hydrogen, by Cavendish as well as by Lavoisier, and further tells us, that Monge shortly after ascertained independently the same facts. So Lord Brougham, in his "Life of Black," tells us that oxygen gas was discovered in August, 1774, by Priestley, and soon after by Scheele, without any knowledge of Priestley's former discovery. Humboldt, in his Kosmos, (p. 345), further reminds us that the same discovery was subsequently made quite independently by Lavoisier and Trudaine, in 1775. Indeed, every department of learning affords examples of the kind to which we are directing our attention. Thus, both Young and Champollion lay claim to the first discovery of the phonetic character of the Egyptian hieroglyphics. William Smith, the English geologist, had been, although unknown to him, anticipated in some of those careful and elaborate generalizations which he made, and upon which, indeed, the whole of that magnificent science is founded; for long before him, we are told that Letman, a mineralogist and director of the Prussian mines, published a work in which he classified the rocks into a primary, secondary, and tertiary division, in the same year that Arduino, an Italian naturalist, proposed a similar arrangement. So again, as an example in architecture, we may, by reading the travels of Pallas through portions of the Russian Empire, or of other oriental travellers, find, as has been observed, ample proof of the existence of that style which is more generally known by the name of Gothic, haply *not* falsely so called, long before our earliest European churches were built. As a further example of this co-ordinate discovery, we may refer to that noble one very recently made by Major Rawlinson in deciphering the cuneiform inscriptions on the monuments of Nineveh, but in which he had been partially anticipated by inquirers at home. This was again a very singular instance, because the Major's mode of inquiry was as original as its result was important and interesting. Another recent instance occurs with regard to what has been called "Great-circle sailing." But we must refer our readers to the pages of the Athenæum for the particulars of it.§

On the subject before us, it obviously matters not whether the discovery or invention is in all its minute particulars identical; it is sufficient for our purpose that the great fact, or law, or principle involved in it, was identical. Beccaria had shown that rock crystal, like Iceland spar, has the power of double refraction, and Rochon availed himself of this property to construct, in 1777, a very delicate micrometer, though Boscovitch, about the same time, appears to have conceived a similar idea. Dr. Maskelyne had, more than a year before, pursued a path little different; his micrometer consisting of moveable glass prisms. Now, to call in the aid of kindred occurrences, would be to prove what the philosopher of old alleged, that there is no new thing under the sun. But we do not require them at present. We simply wish it to be understood, that co-ordinate discovery is not restrained to limit of subject, but pervades all departments of thought, learning, and even practice. We will give two further instances. Dr. Prout, in his Bridgewater Treatise, informs us that Mr. Daniell, very lately, propounded his theory respecting the trade winds without being conscious of the same having been suggested by Hadley more than a century ago. And Mr. Macaulay, in his "History of England," says, in so many words, that the thought of the petition of the Lords' parliament, in 1688, seems to have occurred at once to the two great chiefs of parties, who had long been rivals and enemies, Rochester and Halifax: they both, independently of one another, consulted the bishops.

The instances above given of discovery or invention at different times, or in different places about the same time, are capable of teaching many things which, if we cannot readily learn, we have only to look about us a little, to learn. Exercising our thought but very slightly in this way, and naturally beginning in the more simple field, we observe the savage tribes of all nations. We have already occupied so much more space on this subject than we had at first intended, that we dare not venture to jot down all that has attracted our attention in this survey of the lowest forms of human industry. We must content ourselves with stating the conclusion at which we have arrived, namely, that at a certain stage of civilization, allowing for difference of climate and surrounding circumstances, man is uniformly the same. He seems, in what he produces, to be as a machine wound up for a purpose; its accomplishment more or less delayed, according to the strength of the main-spring within. The canoe, hollowed out from a single tree, is proved to have been as actually as at this very moment, even now, on some coasts, to be one of the earliest methods of navigation. The painted tattoo is also, probably, universal among the people of temperate climes, whenever art begins its career in personal bedizenment. One other instance must at present suffice. We give it as related by a popular writer:—

"In the account of Pompeii, published among the volumes of the Library of Entertaining Knowledge, is afforded a striking instance with reference to the vapour

* Kosmos, v. 2, 252, 3.
† Ency. Brit. 3d Diss. p. 479.
‡ Ib. 4th Diss. p. 619.
‖ Vol. III., p. 134, ed. 1847.
§ May 11, 1850, p. 508.

both, not only of the similarity of the means employed for producing a similar effect, by individuals between whom no communication can be traced, or even supposed, but also a similarity of custom with reference to the enjoyment of social intercourse between communities, not less widely separated from each other by time and place than by degree of civilization; between the luxurious inhabitants of Imperial Rome, eighteen centuries ago, and the savage tribes of north-western America at the present day.

"It appears that the peasants of Russia, and the savages of North America, are in the habit of employing the same means for converting *water into vapour* which were employed by the Romans at the most luxurious period in their history; and to the peasants of Russia, and the savages of North America, may be added the natives of New Zealand, and other islands of the Pacific ocean, merely with this qualification, that they employ the steam so raised not for the purpose of a vapour bath, but of dressing their food."*

Now, it seems totally impossible for us to put this and that together without recognising original discovery and original invention in what, under other circumstances, would be but dry imitation. Locke has a few words on this point, which we here transcribe:—

"Many things may seem new to one that converses only with his own thoughts, which really are not so; but I must crave leave to suggest, that if, in the spinning them out of his own thoughts, they seem new to him, he is certainly the inventor of them, and they may as justly be thought his own *invention* as any one's, and he is as certainly the inventor of them as any one who thought on them before him: the distinction of invention or not invention lying, not in thinking first or not first, but in borrowing or not borrowing our thoughts from another; and he to whom, spinning them out of his own thoughts, they seem new, could not certainly borrow them from another."†

We must endeavour to root out the old idea of genius for discovery and invention being rare among men. Taking the directly opposite view of the matter, perhaps we should be more correct if we stated, that it was a matter of common daily household life. Such an assurance, at all events, whether right or wrong, would give us a more ennobling idea of human power than that which the contrary has tended to thrust upon a too easy world. We would have our readers believe and know, that great men abound more among men than they have been taught to suppose. They require but a more microscopic observation to find out. Haply, the greatest of all may be at this moment directing his swift and fiery courser over Chat Moss, or seated thoughtfully at a loom within a hundred yards of our own domicile—bearing all things, hoping all things, and letting his thought freely range over such part of the universe as he has made his own—may be thinking out for the first time, to his knowledge, some master idea, in which he has been anticipated only by some illustrious individual whose fame was built upon its promulgation. Why not? The style may be the same, although the quality may differ; and in the style of such things it is—in their "method"—we must look to learn somewhat. Leibnitz may have anticipated Newton, or Newton Leibnitz, with regard to fluxions. Copernicus is not less justly respected for having appeared long after Pythagoras in accounting for appearances in the "solar system," by suggesting the theory to which no child is now a stranger. Is Dalton to be less revered for not having been, as he might have been, instructed in his celebrated thought by Higgins; ‡ or, because Edmund Burke had arrived, independently, at some of the same grand conclusions, are we to give less honour to the retiring labours of Adam Smith for having given them commanding among our legislators?

If we make the survey in the widest field that is open to us, each individual must at last come down to his very self, and if, in the above lines, we have learnt anything, and taught what we have learnt aright, we shall have led our reader, without becoming intoxicated with his own perfection, to feel and know that there is *a something* within him capable of yet doing *a somewhat* which will demonstrably exceed all his past effort, little or great as it may have been. Humility is indeed loveable; but it is only so when it is also just. Pride, when it is not distinguishable from consciousness of power, is pleasure of the highest grade, which, in exercise, is virtue of the noblest form.

A SMALL HYDRAULIC PARADOX.

The following small hydraulic paradox may perhaps form a suitable supplement to my "Small Hydraulic Question" of December last.§

Supposing that in a channel of rectangular section, the mean velocity of the water is $= v$ feet per second, the virtual head at any point is $= \frac{v^2}{2g}$, and the quantity of water passing in the unit of time is represented in cubic feet by the continued product—

$$v \times \text{depth} \times \text{width of the channel.}$$

* Kidd's Bridgewater Treatise, pp. 115—117.
† On Human Understanding, b. 1., c. 2, § 1.
‡ See Hist. Induc. Sciences, Vol. III., p. 165, ed. 1847.
§ See page 196, *ante*.

Let us now suppose that a sluice exists at this point, where our observation is made, and that all the given circumstances are in a state of permanency. If the lower edge of the sluice-door is brought *very nearly* to touch the surface of the water flowing beneath it, and there fixed, the discharge will continue unaltered. But if the water is for an instant disturbed, and the surface of the stream is thereby made to rise and touch the edge of the door, it will not again subside to its former level, but will rise on the approach side of the door to a certain definite height, and the water, under this increased head-pressure, will now flow through the opening without any alteration whatever of the quantity discharged. Or, what shows the conditions still better: if a by-wash is provided at or about the level of the lower edge of the sluice-door, a quantity of water, amounting to a very considerable per centage of the whole, will flow over it, and not pass beneath the sluice-door at all, notwithstanding that the opening has still an area equal to the transverse section of the stream previous to its being brought under the influence of the sluice.

The consequence, then, of merely allowing the water to touch the lower edge of the sluice-door, is to reduce the discharge in the channel, without any reduction whatever of the water-way. The case is one of those paradoxes which we sometimes meet with in mechanics when we pass from one set of conditions to another. From being a simple case of the flow of water in an open channel, it passes into that of a sluice of the first kind—in which the water flows away unimpeded, in consequence of the edge of the door being as high as the surface of the water in the stream beyond it. The formula for the quantity of water discharged by such a sluice in a second of time is

$$Q = \mu A \sqrt{2gh + v^2}$$

In which we represent by—

A, the area of the sluice-opening, in square feet;

h, the head of water above the edge of the sluice-door, on the approach-side;

v, the velocity with which the water approaches the sluice;

μ, an empirical coefficient which depends on the nature and form of the channel at the point where the sluice is situated, and which is generally taken $= 0{\cdot}6$. It is, however, a complex function of h: it increases as h diminishes, but never becomes 1.

Now, if the water merely touches the edge of the sluice-door, and does not rise to any appreciable height above it, in consequence of the by-wash which we have assumed to be provided for its escape by the sides of the channel should the level rise, then h is indefinitely small, and the formula becomes simply—

$$Q = \mu A \times v$$

The coefficient, μ, does not disappear, for the edge of the sluice-door, although there is now no head of water upon it, still continues to produce the same kind of influence it previously exerted on the flow of the water; it, in fact, continues to produce the same kind of influence on the flow of the water as the edges of an aperture cut through a thin plate in the side of a cistern filled with water. There is now no stationary head producing the discharge, but there still remains the virtual head $= \frac{v^2}{2g}$, and of this μ is a function.

We may also, from the general formula, determine the height, h, to which the water must rise on the approach side of the sluice-door, in order that the same volume of water may continue to be discharged by the sluice as in the open channel. We have, by a simple transposition—

$$h = \frac{1}{2g} \left\{ \left(\frac{Q}{\mu A} \right)^2 - v^2 \right\}$$

Suppose that we take a numerical example for illustration. If $v = 4$ feet, and the depth of the water in the channel is 2·5 feet, and the width 20 feet, then the transverse area of the stream is $= 50$ square feet, and the quantity of water discharged in the unit of time, when the channel is entirely open, is—

$$A \times v = (50 \times 4 = 200) \text{ cubic feet.}$$

But if the surface of the water is made to touch the edge of the sluice-door, then the coefficient, μ, must be introduced into the calculation; and, supposing the by-wash to be pretty nearly on a level with the edge of the sluice-door, and very large, then μ may be taken $= 0{\cdot}75$. We shall have, accordingly, only $(200 \times 0{\cdot}75 = 150)$ cubic feet of water passing through the sluice, and, consequently, 50 cubic feet running over the by-wash.

And again, supposing that no by-wash is provided, but that the water is permitted to rise on the approach-side of the sluice-door sufficiently

ROLLING INCLINE MOVEMENT.

Fig. 1.

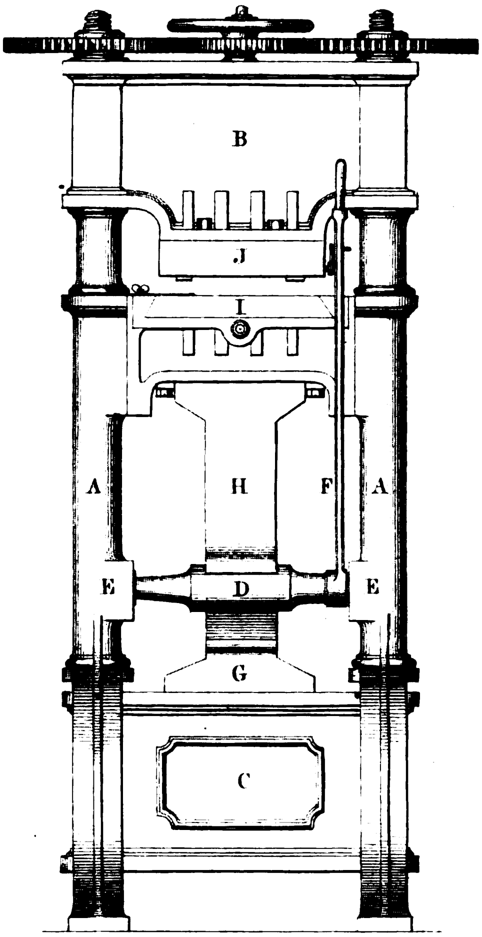


Fig. 2.

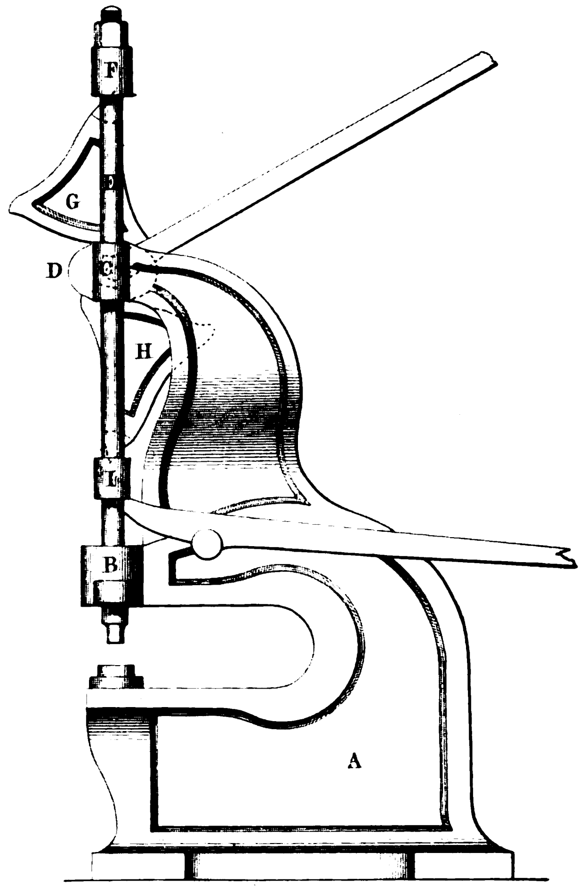


Fig. 3.

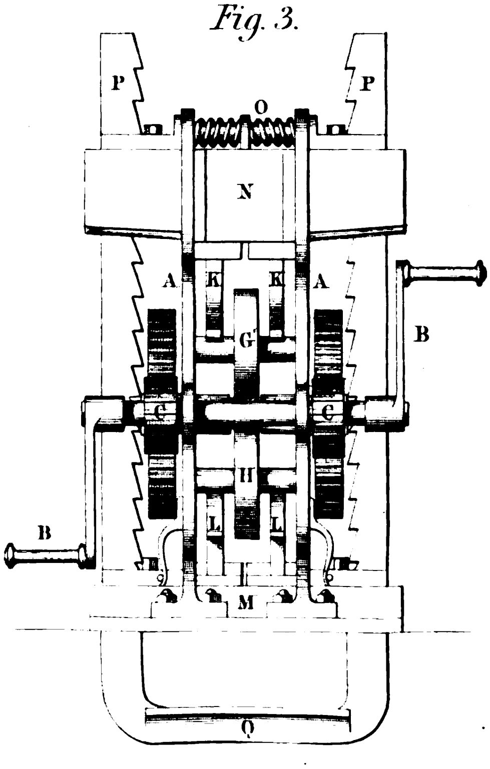
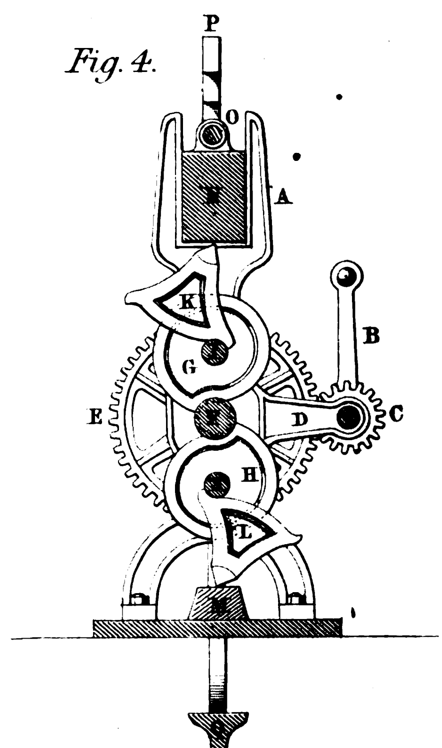


Fig. 4.



high to cause the whole of the 200 cubic feet per second to flow through as formerly, then the height to which the level will rise is given by—

$$h = \frac{1}{64\cdot 4}\left\{\left(\frac{200}{50 \times 0\cdot 6}\right)^2 - 4^2\right\} = 0\cdot 442 \text{ feet.}$$

These conclusions, especially this last, are very easily verified in any mill-lead of regular form, by means of a temporary sluice introduced into the channel.

β

THE ROLLING INCLINE MOVEMENT, AS APPLIED FOR PRESSING, PUNCHING, OR EMBOSSING, AND PILE DRAWING.

(Illustrated by Plate 90.)

This very beautiful invention, the introduction of which into this country we owe to the Great Exhibition, where it deservedly carried off a council or first class medal, for its inventor, Mr Dick, of Pennsylvania, United States, is now being extensively introduced into our workshops, by Mr. Gwynne of Parliament Street, Westminster, its present possessor. Pre-eminently simple in mechanical arrangement, the "rolling incline" affords a range of pressing force fully equal to that of its more complicated rival, the hydrostatic press, whilst it far excels the latter in rapidity of motion and general facility of application.

Our plate 90 exhibits three several modifications of the movement. Fig. 1 is a front elevation of it as adapted for an ordinary goods press, instead of the hydrostatic packing press used by manufacturers. Fig. 2 is a side view of a simple hand punching or embossing press; and figs. 3 and 4 are front and side elevations of a pile or stump drawer.

The involved principle of this new action is the pure rolling movement of variously formed eccentrics or cams, without the slightest frictional sliding; and, consequently, friction is all but annihilated in it. It is on this account that we have named it the "rolling incline," a term pointedly expressive of the peculiarity which distinguishes it from all other applications of inclines. As we shall give next month an additional plate of some of the many practical applications of the plan, together with a set of illustrative diagrams of its action, we shall delay further detail until that time.

PATENT LAW AMENDMENT.

Since the appearance of our article on this subject last month, the alterations mentioned, or rather, such of them as the Act of Parliament actually enacted and made obligatory upon the several officers of the Crown, have necessarily been made. As is usual in such cases, the interests of officials have stood in the way of any very material alteration, either in the time occupied in passing patents, or in the amount of fees to be paid thereon.

The reference by the secretary of state to the law officer, and his report, remain as before, the "Patent Bill" being, however, dispensed with. It appeared natural to expect that, in doing away with that stage, a very considerable expense would be avoided, the cost of the patent bill, prior to the passing of this act, being £15. 16s.; but here the inventor is disappointed, for are there not officers of the Patent Bill Office, the clerk of the patents, the clerk of the bills, and their deputies and their engrossing clerks, to be provided for? If there are no necessary duties of the office left, then duties must of course be created for them, and fees paid to them, as is our just and invariable system in law reforms. If we abolish some unnecessary piece of legal form, which has been for years a source of patronage in the hands of the government for the time being, the onerous duties appertaining thereto having been laboriously fulfilled by a regular attendance at the office, in company with the "Times," from ten till four, with a vacation of the autumnal months, to recruit the officer's wasted energies, then that officer must have some equally trying duties imposed upon him, with an income attached of at least a similar amount, or he is a fit subject for "compensation." Or, in many cases, he pleasantly combines the two; he has an office found for him, which employs his talents in the agreeable manner we have described, and he is also "compensated." But we are digressing too much from the subject, and our readers will doubtless have concluded that our party is "out."

The warrant for the patent, which has heretofore been prepared at the Home Office, is now prepared by the attorney or solicitor general, and is made to take the place of the defunct bill. The Bill Office, and the gentlemen attendant there, are retained in *statu quo*, to prepare this document, which they do for the moderate sum of £9. 18s. 6d., this sum including the fee of the attorney or solicitor general for affixing his signature to it.

This warrant, then, prepared as we have mentioned, an indifferent person might probably have imagined, would have been at once completed in this office, for the £9. 18s. 6d. But nothing of the sort. There are the officials at the Home Office, who have as yet had very little out of the patent, merely the £2. 2s. 6d. for Sir George Grey's signature to the reference. It is necessary that this warrant should receive her Majesty's sign manual, and should be countersigned by Sir George Grey. Of course the Home Office is the proper channel for obtaining these signatures, and when we come to pay for their obtainment, we find the fee is exactly the same as heretofore paid, when the warrant was altogether prepared in this office; so that for this warrant we have already paid £9. 18s. 6d. and £7. 13s. 6d., or exactly £9. 18s. 6d. more than the same document formerly cost us. After the lapse of some days, the warrant having been signed by her Majesty and the secretary of state, it is necessary that the privy seal should be affixed to it, and as, by the act affecting the changes, it is enacted, that the office of clerks of the privy seal shall be abolished, and the duties of the office performed by the clerks in the treasury, it might be supposed that here again the inventor had been considered. We regret to say that this abolition of office is merely in name, for we find the gentlemen formerly clerks of the privy seal, comfortably located at the treasury, and the reduction in their fees is, in reality, 2s. only, with the same additions in regard to the colonies —two or more names being included in the grant—special seals and expedition fees—as formerly. We have now arrived at the Great Seal, but here the duties to be performed being as before, the fees are consequently the same.

The actual reduction in the entire cost is £18 upon each English patent, making the cost to the patentee £92, instead of £110 as formerly. The time occupied in passing is slightly shortened, but at present the act has been so short a time in operation, that we can give no definite statement as to this.

It is scarcely likely that Parliament will attack this neglected branch of our law during the ensuing session, but our readers may rely upon our placing before them the earliest intimation of any alteration that may be mooted.

MECHANIC'S LIBRARY.

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Ship from the Cradle to the Grave, History of, sq., 3s. 6s., cl.

RECENT PATENTS.

"CLOUDING" YARN.

W. Geddes, *Glasgow.—Enrolled December* 6, 1851.

The term "clouded" is applied to yarn which has imprinted upon it, at regular intervals along the threads—spots, or marks of colour, so that, when woven, it produces a peculiarly tinted or figured fabric. Hitherto the several processes employed for giving the clouded effect have been worked under the severe drawbacks of tediousness and great expense, both which are now removed by the simple and effective arrangement employed by Mr Geddes. The yarn to be operated upon is first dyed with indigo, or other colour, and wound upon a roller at one end of the clouding machine. From this roller it is passed between a pair of grooved impressing rollers, which are set horizontally, and are geared to work together, so that the grooves on each shall continually correspond. These rollers work in contact with feed rollers, beneath which they dip as they revolve—into troughs filled with dilute nitric acid, thickened, so as to produce a printing body, with clay or whitening. In this way the clouding rollers are supplied with the acidulated matter, and, as the dyed yarn passes between them, they impress their acid coating on each side of the yarn by the counter pressure of each pair of projecting ribs, thus laying transverse streaks of the composition on the layer of yarn as it passes along, for the purpose of discharging the dye at those parts. From these rollers the printed yarn passes round a guide roller, having sharp longi-

tudinal ridges, for the purpose of directing the yarn, without blotting or disturbing the newly-formed marks. Thence it passes over a sheet-jet of steam, the action of which aids the effect of the previously-applied lines of acidulous impressions, clearing off the deposited matter, and leaving the lines of such impressions clear, white, and regular. After this treatment, the yarn passes through a cold water washing chamber, and is finally wound upon a beam at the end of the machine. This process, in the present instance, gives to the yarn a series of regularly uniform white lines—that is, white and blue lines alternately.

This system of operating on yarn is also applicable for discharging colour by various agents, and by a slight modification, the acidulated impressions may be treated with hot water, instead of the steam-jet; or, by first passing the treated yarn through cold, and then through hot water, a light blue is produced instead of the white lines, when using indigo as the dyeing colour; or, instead of this arrangement, the dyed yarn may be first impressed with a semi-fluid solution or mixture, of bi-chromate of potash, and afterwards passed through a solution of oxalic acid, or other acidulated compound, for the discharge of the dye.

FINISHING THREAD.

John Macnab, *Midlonfield, Renfrew.—Enrolled January* 17, 1852.

Mr. Macnab's invention comprehends an excellent arrangement for stretching and drying thread, yarns, or other textile materials, by the joint action of frictional tension and heat, so as to strengthen, improve the quality, remove "snarls," twists, or irregularities, and give a finished appearance to the thread.

The apparatus consists of a pair of parallel framing standards, each of which has a series of wide vertical slots in it, at regular distances asunder, and outside each standard are bolted, by their ends, a correspondingly uniform series of hollow steam chambers, the transverse section of each of which resembles a blunted wedge with the point turned upwards. In each case the chest projects to a considerable distance from the face of its supporting standard; and at a short distance beneath it, is a second, or lower chamber, projecting to the same extent, and forming, as it were, a continuation of the lower blunt end of the wedge above, both chambers being in connection by short branch-pipes. In the patentee's drawings, each standard has four sets of these chambers, forming eight distinct finishing actions, the chambers and mechanism in both standards being directly opposite to each other, so that the finishing movements are worked in pairs. A steam-pipe runs along each standard, to supply the chambers with steam heat, and directly beneath, is a heated air case, through which air is conveyed from a fan blast, and distributed by projecting branches, extending so as to fill up the space between each of the upper and lower steam chambers. Each branch has a narrow slot throughout its whole length on each side, to allow the heated air to escape in two opposite narrow jets or streams.

The necessary motion for producing the frictional action is derived from a main horizontal shaft beneath, which actuates by suitable mechanism, a series of swifts or thread barrels, one to each action. Each of these swifts, together with the lower portions of the hanks of thread under treatment upon them, is surrounded by a wooden air chamber, standing up from a horizontal hot-air duct beneath; and each of the upright portions of these chambers has an internal narrow slit, opening in near contact with the outside of the thread, as it is carried along by the revolution of the swift.

In treating thread by this machine, the hanks, in their wet state, are passed over the blunt ridge of the upper steam chamber, and over the corresponding swift beneath. Each opposite pair of swifts is driven by the same horizontal shaft, carried in bearings, suspended from a weighted cross-head, guided in the opposite slots in the standards; and, when the thread is placed on, the weighted swifts are permitted to descend, and give tension to the yarn, thus drawing it tight over the upper ridge of the steam chamber. The swifts are then put in rapid motion, and the thread so stretched upon the ridge is carried round, and traversed over the sides of the upper and lower steam chambers. At the same time, heated air is blown through the slots in the upper hot-air branches, against the *interior* surfaces of the traversing hanks of thread; whilst the *exterior* surfaces of the hanks are similarly acted on by air currents from the upright cases, or air chambers, beneath. In this way, each set of hanks is acted on by four distinct heated air-jets, and the effect of this treatment is, that whilst the tensional strain of the thread over the upper steam chest removes the snarls or irregularities of twist, and stretches out the fibres to a uniform bearing, giving a rubbing finishing action to the material, the heated air blown upon it, carries off whatever moisture is present, and aids the effect by the heat so supplied. When the operation upon a supply of thread has been completed, the swifts are stopped, and an ingenious piece of mechanism is put in action, for the purpose of elevating the swifts to admit of the removal of the finished thread. Although the general arrangement which we have described, promises to be the most effectual for the treatment of thread, Mr Macnab states that revolving steam-heated cylinders may be used instead of the wedge-shaped chambers; or the thread may be passed over upper and lower steam-heated cylinders, but the tensional friction over the fixed wedge-shaped chamber will evidently give the best polishing action.

STEAM DIGGING MACHINE.

George Guthrie, *Rephad, Stranraer.—Enrolled September* 24, 1851.

Most of our readers will be already acquainted with the strenuous efforts which have been made in late years, to secure the more general use of steam-power in agricultural operations, and many of them will have learned that, with the exception of the employment of a large number of small portable engines, and here and there a steam-thrashing mill, and chopping apparatus, we are still far behind in the adaptation of mechanism to agriculture, Worst of all, we have not yet a satisfactory steam-plough, although Lord Willoughby de Eresby, the Marquis of Tweeddale, Messrs Curtis, Usher, Callaway, Purkis, and others, have for years devoted their time to the scheme.

In the plan now before us, Mr. Guthrie appears to have struck out a new system, in his attempt to produce a mechanical digging action. assimilated as closely as possible to the principle of manual digging. His proposed machine, which has been recently built by Mr. Macdowall of Johnstone, consists of a powerful rectangular frame, carried on four travelling wheels with broad rims, to enable them to pass easily over the land to be operated upon. The motive power is derived from a pair of steam-engine cylinders, placed one on each side of the framing, and arranged to actuate the digging apparatus, through the intervention of cranks and gearing, as also to give the whole machine a progressive traversing movement over the land. The front end of the frame bears upon the centre of the axle of the front pair of wheels, as in an ordinary carriage, so that the wheels may turn beneath the frame to guide the machine, these wheels being loose upon the axle, to admit of turning. The upright bearing of the frame on the front axle is so arranged, that the fore end of the frame may be elevated or depressed by suitable gearing. Of the two larger hind wheels, one is loose on its axle, and the other fast, to serve as a driving wheel. The machine is steered at the front end by a vertical hand-wheel shaft, carrying a pinion at its lower end, gearing with a toothed segment fast on the upright bearing of the front wheels.

At the opposite, or digging end of the frame, is placed the first motion shaft of the engine, which actuates an upper and a lower crank shaft for the digging movement. The digging implement, as shown by the patentee's drawings, is a grape, or fork, having a long sliding shank, the upper end of which is formed into a spiral, or screw, of coarse pitch. The extreme upper end of this shank is hinged to a connecting-rod from the upper crank shaft, which serves to give the downward dig, whilst a second connection at the same place, to the end of a fixed link, directs the stroke, so as to give a species of scooping action. The lower crank shaft has a link attached at its opposite end to a sliding nut in the moveable frame of the digging fork; and as the crank revolves, the traverse of the nut over the spiral, causes the fork to revolve half round on its spindle, carried in bearings in the frame. When the upper crank has descended about half its stroke, the pin of the lower one presses on the back of the fork, drawing it backwards, so as to cause it to scoop away the earth; and, as it traverses onwards, brings the fork to a horizontal position. The further traverse of the latter crank, then acting upon the nut of the spiral on the fork spindle, turns the fork over, thus throwing off the earth which it has just elevated. During this action, the whole machine has slightly progressed over the field, so as to bring the fork to a new piece of ground, when the process is repeated. The patentee shows six fork movements set in one line across the end of the machine, but any convenient number may be applied.

Although still unfinished in its mechanical arrangements, this scheme presents the nearest approach to spade labour that we have yet seen—the earth being regularly dug up and systematically turned over, just as the field labourer would perform it.

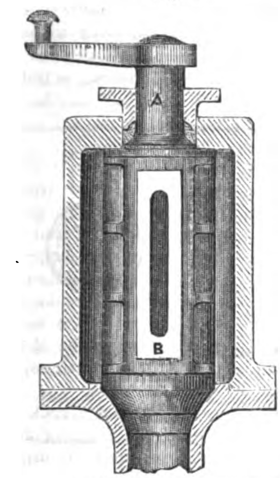
STEAM ENGINES.

Edward Lloyd, *Dee Valley, Corwen, Merionethshire.—Enrolled, August* 23, 1851.

Mr Lloyd's patent embraces three several heads—the construction of valves, the arrangement of double-cylinder expansion engines, and the application of such improvements, or parts thereof, to other motive engines.

The first portion relates to valves of the vibrating or semi-rotatory class.

Fig. 1.



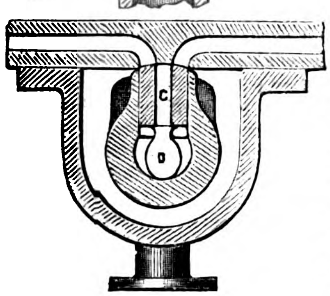


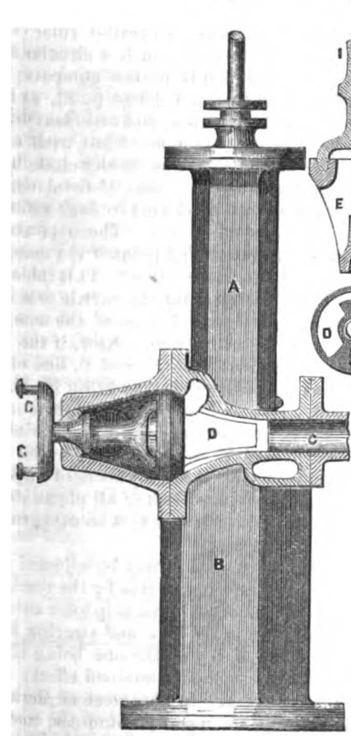
Fig. 2.

Fig. 1 represents one of the arrangements of such valves, the valve-case being in longitudinal section; and fig. 2 is a corresponding horizontal or transverse section. It is worked by the spindle, A, which has a crank lever, or rocking-shaft on its extremity. The facing, B, is cylindrical, C being the valve-port. The face is kept tight by springs, D. The steam enters at the bottom of the valve-chest, and passes up into the hollow of the valve, whence it is admitted through the port, C, to each of the cylinder ports alternately, as the valve vibrates from side to side. One end of the valve is formed to Schiele's anti-friction curve, and works steam-tight in the end of the supply-pipe, and the opposite one has a stuffing-box fitting to a collar on the spindle, also curved to the anti-friction shape. The exhaustion from each port takes place by the same motion, the exhaust steam flowing into the chest, surrounding the valve, as each port is alternately uncovered for the purpose. From this chest it passes off to the atmosphere, or the condenser, by the horizontal branch shown in fig. 2. Various other forms of valves are shown, Schiele's anti-friction principle being largely employed in all of them.

Figs. 3, 4, 5, and 6, represent detailed views of one of Mr. Lloyd's arrangements of double cylinder expansion engines. Fig. 3 is an external elevation of the pair of cylinders, with the valve chest and passages in longitudinal section, and fig. 4 is a vertical section of the cylinders and valves. Fig. 5 is a longitudinal section of the valve detached; and fig. 6 is a bottom end view of the same. The small high pressure cylinder, A, is cast on the top of the larger low pressure expansion cylinder, B. The steam enters at C, and is admitted by the alternate vibration of the valve, above and below the small high pressure piston; and, at the end of each stroke, it expands through the passages, D, into the larger cylinder, whence it exhausts through the passage, E, leading to the larger end of the valve; thence it passes into the eduction pipe leading to the condenser. The valve is worked by a spindle having opposite levers, G, so that the engine's motion is easily reversed. The spindle passes through a bush in the outer end of the valve chest, and afterwards expands into a forked end, fitting loosely to holes in the back of the valve. A rod of the same material as the steam chest regulates the distance between the bush and valve faces, so that expansion may not affect the working. The tightening is effected by a screw, which, pressing on packing at the part I, prevents the steam escape. As the steam pressure obviously tends to lift the valve from its seat, the friction may be nicely regulated by the screw. Both pistons are placed on one rod, which is passed through the division between the cylinder ends, by an internal stuffing-box, the packing in which is contrived to be adjusted by screws externally.

The patentee also shows another form of double cylinder engine, in which the cylinders are placed side by side, still ensuring great compactness.

Fig. 3. Fig. 5. Fig. 4.



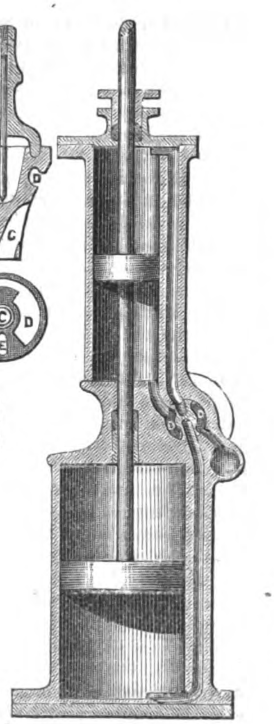


Fig. 6.

REGISTERED DESIGNS.

DOUBLE-EXPANDING AND CONTRACTING SCREW-KEYS.

Registered for MR. J. CHESTERMAN, *Machinist, Sheffield.*

The two distinct designs which we have here combined under one description are by Mr Chesterman, of Sheffield, well known for his many ingenious mechanical contrivances, amongst which may be reckoned his spring-folding tape-measure, as a familiar and useful example.

Our Fig. 1 exhibits a longitudinal section of one of his new screw-keys, partially expanded. The two fixed jaws, A, are connected together by the intermediate piece, B. The other two, or sliding jaws, C, form the terminations of two sliding pieces, which fit into sockets formed in the jaws, A. Each of these slides terminates in a screw, D, set in the same axal line, and arranged to be actuated simultaneously by the brass-coupling hand-nut, E, common to both. The action is simple and obvious. On turning the central adjusting nut, one jaw is expanded, whilst the opposite one is contracted correspondingly.

Fig. 1. Fig. 2.

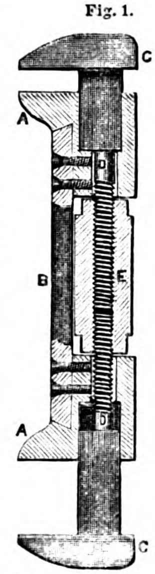


Fig. 2 is a longitudinal elevation of another form of duplex action key of great novelty. In this instance the key is formed of the two main curved levers, A B, each end of which is contrived to form half of a screwing jaw, the two jaws being different in size, for the conveniences of different nuts. To the inner side of the central portion of one of the levers is forged a semicircular projection, indicated by the dotted curve at C, and this projection fits into a corresponding recess in the inner side of the centre of the other lever. This projection then forms the means of jointing the two levers together, by passing a pin through one lever and through the projection. The jaws are adjusted by the two set screws, D, each of which is tapped into one of the levers, through which it projects, to allow its point to bear against the inner side of the opposite lever. It is obvious that, by turning these two screws in opposite directions, either of the jaws may be set to the size required—the opposite jaw being simultaneousaly djusted with a contrary effect.

GLASS GUAGE-TUBE FOR LOCOMOTIVES.

Registered for MESSRS. J. THORNTON & SONS, *Birmingham.*

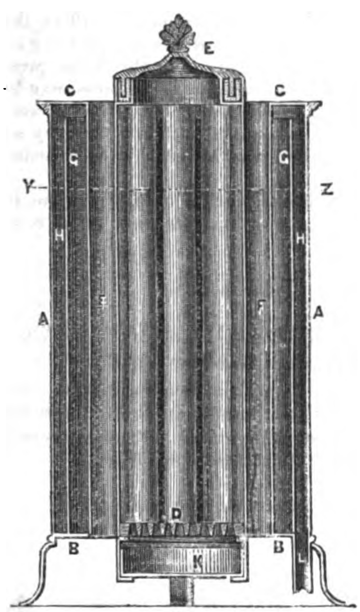
Locomotive engine-drivers suffer constant annoyance from the fracture of their guage-tubes, which frequently give way, one after the other,

without any very satisfactory reason, until chance brings one which stands. Hitherto these tubes have all been made cylindrical, or with parallel sides; but Messrs. Thornton now propose to make them of a barrelled form, that is, swelling from each end towards the longitudinal centre—the relative diameters being as $\frac{5}{8}$ths to 1 inch. As far as the positive steam pressure, or the vibrations and concussions of the engine when in motion, and accidental blows, are concerned, this form seems to offer a very effectual improvement.

DORSET STOVE.

Registered for Mr. John Hicks, *Dorchester.*

Fig. 1.



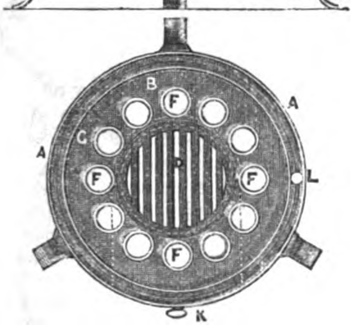


Fig. 2.

This stove, which is now being extensively manufactured by Messrs. Benham & Sons, of Wigmore Street, London, the eminent makers of this class of articles, has for its object the warming of buildings by the combustion of charcoal, the products of such combustion being removed by a descending flue, which leaves all clear above.

Fig. 1 of our engravings is a vertical section of the stove, and fig. 2 a horizontal section at the line Y Z, corresponding. It consists of an external cylindrical casing, A, of sheet-iron, closed at each end by the top and bottom pieces, B, C, in the centres of which are two circular openings. In the lower one is placed the grate, D, and the upper hole is surrounded by a sand groove, to form a tight joint for the cover, E. At F are a series of air tubes open at both ends, and fixed to the top and bottom of the stove. A casing, or lining, G, is attached to the bottom of the stove, extending to within a short distance of the top, and leaving a channel or flue, H, for the escape of the products of combustion, which pass off by the chimney, L. The ash-pan is at K, beneath the grate. The fire is made in the grate, D, within the space enclosed by the lower ends of the air-tubes, F, and the heated air and gases pass between these tubes, and over the top of the lining, G, then down the descending flue, H, and escape at the chimney, L, which may be continued outside the building.

TELEGRAPHIC BELL-BOARD.

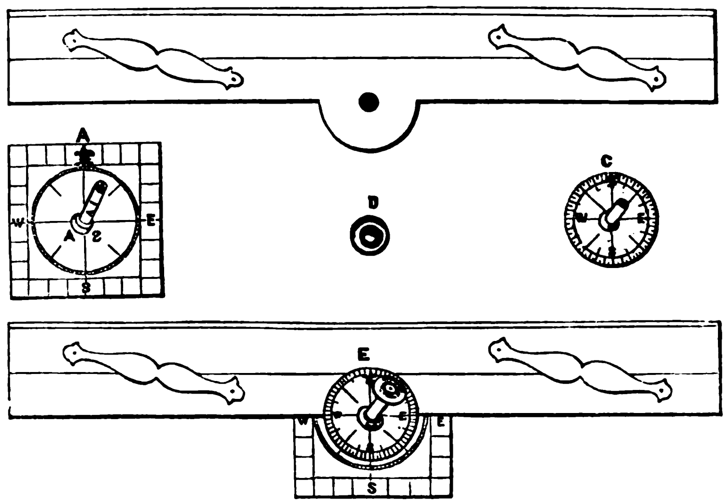
Registered for Mr. John Scartliff, *Asylum Lodge, Lincoln.*

By means of this contrivance, messages may be instantly telegraphed from any part of a building to the proper attendant, by simply pulling a rope. A frame, containing any given number of circular holes upon a flat surface, is affixed to the wall, or any other upright. The messages, or notices, are each written or engraved upon the surface of a spherical ball, which is suspended by a horizontal axis, allowing them to play freely, and expose half of their surface. These balls are connected by cranks with the various apartments, and at the signal being given, a bell is struck, which announces the number of the room upon the board, and the ball instantaneously exhibits the article wanted, which remains in its position until the waiter turns off the signal by means of a small lever. One bell only is required to each board, and only one board for each building.

REVOLVING PARALLEL RULER.

Registered for Captain H. Toynbee *and* J. D. Potter, *London.*

The instrument is shown in detail in the annexed five figures.



The advantages of this instrument are :—

1st.—By having the compass attached to the ruler, bearings may be applied to charts without its being requisite to slide a parallel ruler some distance over the chart, so that time is saved and liability to error avoided; also several bearings may be taken with the instrument in the same position.

2d.—The compass card may be set so as to show the true or magnetic bearings, or magnetic bearings affected by local deviation, depending upon the part of the world the ship is in, and the direction of her head.

3d.—It will construct the figures of the different sailings, and lay down the angles of a survey in a very expeditious manner, no chord of sixty or protractor being required, a pair of compasses alone being requisite.

It consists of a square plate (A), cut round its edges with rectangular lines to represent the meridians and parallels of a chart, and marked with the N. S. E. and W. points; within these edges is a circle divided into 360 degrees, numbered at every ten degrees from the N. and S., towards the E. and W. points. In the centre of this plate, and perpendicular to it, is secured a pin (A 1), on which, as a centre, a parallel ruler (B), is made to revolve, above the ruler. Upon the same pin is a circular brass plate (C), divided into points and quarter points of the compass; this plate is so adjusted by means of a screw (D), and flange (A 2), as to be able to revolve round the pin, or become a fixture at pleasure, leaving the parallel ruler free to revolve. E represents the instrument with all its parts put together. The back edge of the ruler bisects the circle below and compass card above it, pointing out, as the ruler is revolved, the angle which it makes with their respective meridians in degrees of the former, and points and quarter points of the latter. There is also an ivory table upon the ruler, containing every second point of the compass, and headed with "var. of comps.," and "local deviation." This table is to be filled in by the navigator, with the variation for the part in which he is sailing, and the local deviation for every second point of the compass, marking them E. or W., according to their direction. Now, if the back edge of the ruler be brought to coincide with the N. and S. line of the square plate, and the compass card be revolved so as to bring its N. and S. points to coincide with the back edge, and clamped there, it is manifest that when any one of the N. and S. lines of the square plate coincides with a meridian, or any one of its E. and W. lines with a parallel of a chart, then the circle shows in degrees, and the compass card in points and quarter points, the *true* bearing from one another of all places on the chart along the back edge of the ruler, also (these edges being parallel), of all places over which the other edge passes.

But the chief use of the compass card is, that it may be adjusted so as to represent the ship's steering compass, affected as it is by the combined influences of variation and local deviation. Suppose a ship to be entering the English Channel, where the variation is 25° W., and steering E. by S., with a local deviation on this course of 6° E., the one being E. and the other W., the difference, or 19° W., is their combined effect; now, by revolving the back edge of the ruler 19° to the west of the north point of the square plate, and bringing the north point of the compass card to agree with that edge, and clamping it there, the card represents the steering compass so long as the ship remains upon that course.

Suppose now that the commander, knowing his position on the chart, finds by means of this instrument the bearing of the Caskets to be E. by S. ½ S., they will have the same bearing from the steering compass, and an E. by S. course by it will weather them; but had no deviation been applied to the chart compass, E. by S. ½ S. by it would agree with E. by S. by the steering compass, which course, if continued on, would take the ship upon the Caskets. This, of course, is well known; we merely give the case to show that this method seems to lessen the liability to error in applying the local deviation, which to some is very perplexing, and by making its application simple, may induce many to allow for it who have previously neglected to do so.

Again, suppose the above ship to be in exactly the same position, but steering W. by N. with a local deviation of 8° W. for that course, this, added to the var. 25° W. (because they are of the same name), gives 33° W. for their combined effect, and the Caskets would bear S. E. by E. ¾ E. by the adjusted chart compass, as well as by the steering compass. The north point of the square plate must point northwards on the chart, and any one of its rectangular lines must coincide with any meridian or parallel. The centre of the square plate must be kept out of the line of direction of the bearings. By a little practice, it is found easy to place it so that it will lay down several bearings without moving the square plate. By means of the circle, the instrument lays down angles to degrees, and a scale of equal parts upon it gives the length of the sides of a required figure.

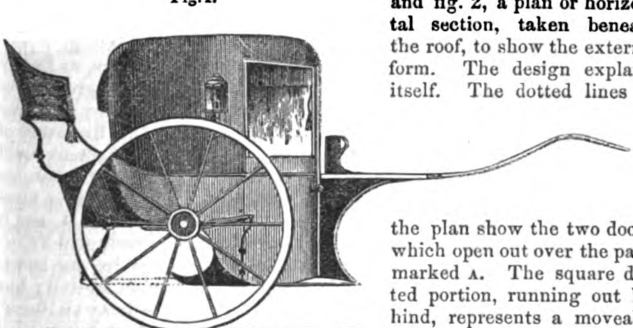
To lay down a survey, it would be useful to have a compass card divided to degrees, numbered from the north point 180 degrees each way; the rectangular lines being drawn round the margin of the paper, would, like the meridians and parallels of a chart, supply the means for placing the instrument, and in laying down the plan, any line having been drawn to make a required angle with another, before moving the parallel ruler, the north point of the card may be revolved to coincide with the back edge of the ruler and clamped, then will the north and south line of the card represent the last line drawn, which may be carried to any other part of the paper, or another line may be drawn making any required angle with it, the same plan being followed throughout.

BROUGHAM CAB.

Registered for Walter de Winton, Esq., *Lamb's Conduit Place, London.*

Mr. de Winton's "Brougham Cab" forms a very elegant street vehicle. Handsomer than the favourite "Hansom," it will yet probably run as light, if suitably built.

Fig. 1.



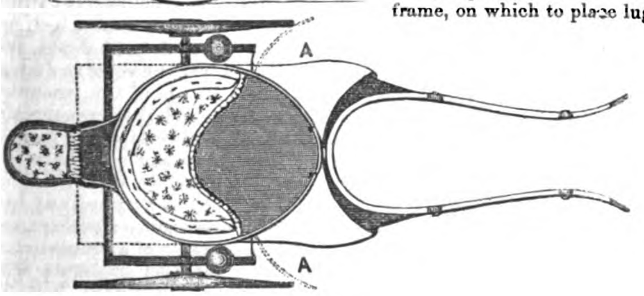


Fig. 2.

Fig. 1 is an external view, and fig. 2, a plan or horizontal section, taken beneath the roof, to show the external form. The design explains itself. The dotted lines in the plan show the two doors, which open out over the parts marked A. The square dotted portion, running out behind, represents a moveable frame, on which to place luggage, to be protected from rain or dust by an oilskin cover. It is a roomy vehicle, more complete and serviceable, in many respects, than its prototype.

FIRE-PROTECTOR FOR IRON SAFES.

Registered for Mr. T. W. Stephens, *St. James Street, Dublin.*

Our engravings represent Mr. Stephens' invention in three views. Fig. 1 is an external elevation of the safe chamber, on the ground floor of the bank or office in which it is fitted. Fig. 2 is a corresponding vertical section of the chamber, showing the safe as suspended above the "refuge chamber," into which it falls in case of fire; and fig. 3 is a plan of the safe. The horizontal line, A, shows the level of the floor line, upon which is built the brick chamber, B, guarded by a pair of iron doors, C. The safe, D, is suspended within this chamber by the gutta percha band, E, so that in case of fire, when the heat becomes sufficiently great to melt wax, the band gives way, and the safe descends into the refuge chamber beneath, where it is out of harm's way. The iron plate, F, at the top of the chamber, covers up the top, and prevents the entry of any fire.

Fig. 1. Fig. 2.

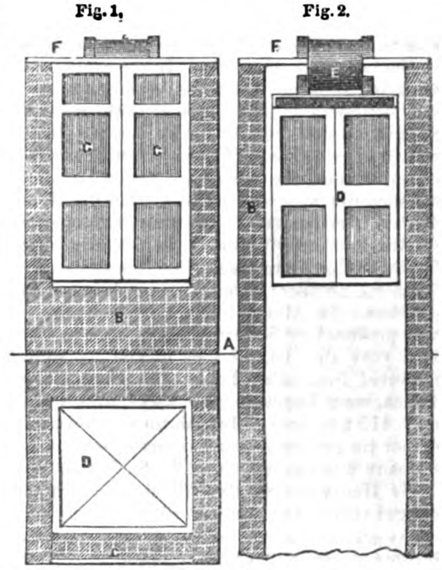


Fig. 3. 1-64th.

Safes, on this principle, may be erected on any upper floor, by continuing the chamber upwards, existing safes being capable of easy alteration to the new arrangement.

REVIEWS OF NEW BOOKS.

Lectures on the Results of the Exhibition. Lecture II., by Sir H. T. De la Beche, C.B., F.R.S. Mining, Quarrying, and Metallurgical Processes and Products. London: D. Bogue. Pp. 73.

Every one comes to the observation of any matter, from simple external fact to the appreciation of some sentiment, which, as the very name implies, to be understood must be felt, under totally different circumstances, including the essential differences in time and place. It is largely well that this should be so. To the circumstantial evidence which is thus brought forward in support of truth, as well as in prevention or eradication of error, are mainly attributable all enduring forms of utility, beauty, and every other moral quality which man may consider he has honestly come by. A book may be taken up for study or amusement. If for study, it must be either to increase our store of truths, or to learn some method of imparting those which are already known. If for amusement, why, of necessity, it must be to do either one of the same things, but in an unconscious manner. *Volens* or *nolens*, we are ever under the rod of the Great Instructor. To the best informed it is the most obvious, that they who come best prepared to observe, observe to the greater advantage, and that they who have best observed can more readily impart to others a portion of that power which has by diligence been acquired.

The parties having the selection of these lecturers, whoever they may be, did well in choosing Sir Henry De la Beche as one of the number. We might, probably, without any difficulty point out a more microscopic observer, a more "minute philosopher," than Sir Henry, in some particulars, comprised in the large field of observation in which his life has roamed; but to none among his cotemporaries can we attribute greater capacity for exercising, synthetically as well as analytically, that power which he has devoted to the subjects before us. When a man like this speaks, he has *a right* to be heard; and we *must* hear him. Our free will becomes necessity, that is, provided we guide ourselves like sane men. We forget, however, the necessity as well as the liberty in the pleasure derived from the teachings of the gifted and instructed mind.

In the lecture before us, Sir Henry hastily passes in review the various mineral substances and alloys used either for substantial profit, or simply for ornament. Coal, iron, copper, lead, zinc, tin, silver, gold, platinum, palladium, iridium, rhodium, steel, brass, plumbago, "or black-lead, as it is so erroneously termed," are successively descanted upon. Observations follow upon other specimens in the Exhibition, such as building stones, marbles, serpentines, porphyries, granites, slates, grind-stones, porcelain or china clay, fossil bones, teeth, coprolites, clays, and, in the last place, the gems. In the course of these observations, some interesting statistics are given, which, coming from so high an authority, may doubtless be relied upon as authentic. We are told that the annual weight of coal raised in this country, approaches, in all probability, nearly forty millions of tons; of which not quite a sixteenth part is exported, and the remainder is employed for domestic and industrial consumption at home. The gross annual production of iron in Great Britain is estimated to be now upwards of two millions and a half of tons. Of this quantity it appears that South Wales furnishes 700,000 tons, South Staffordshire (including Worcestershire), 600,000, and Scotland the same number; the remainder being divided among less important districts. Sir Henry informs us that the iron of England and Wales was produced by 336 furnaces in blast in 1850. As regards tin, during that year also, 10,052 tons of the ore were raised. Tin is, however, imported from other lands. In 1850, 1,798 tons of tin, chiefly from Banca, were imported, and 2,211 tons were exported, "showing that only 413 tons tons of British tin found its way elsewhere; the chief part of our tin produced being reserved for our own industry, for which it is in many ways so important." Such statistics are always pleasing.

Sir Henry notices the fallacious appearances often exhibited of the alleged richness of mines in the following manner:—

"As mineral matter in its first, or natural state, cannot be modified by man, it becomes important that when specimens of it are shown as illustrative of mineral wealth, especial reference should be made to those processes by which such mineral matter is rendered useful. Without this precaution much misconception may arise. Let us, for example, consider the ores of the metals. The mere exhibition of any ore, however rich, is in itself of little value beyond the information that the specimen came from some stated locality. The circumstances connected with its mode of occurrence, and with the means at command to render its extraction useful, are essential. Pieces of rich ores are of frequent occurrence in localities where, from a want of their sufficient abundance, it would be useless to attempt any profitable working of them. Hence collections of ores may often be most fallacious; indeed it is unfortunately somewhat too common to find specimens of ores shown as the ordinary products of mines where they are really rarities, for the purpose of promoting the purchase of shares in such mines. There is a name for such specimens in Cornwall, where they are termed *slocking stones*. These really come from the mines, but they are unfair representations of their produce."

In the afterpart of his discourse, the lecturer further alludes to the ignorance that is often deluded in these matters by the cunning adventurer. The knowledge which he would have to prevail on the subject "is no less important," he says, "to numbers of persons daily speculating in mines, ignorant of all connected with them, except the traffic in shares. It is not a true inference, as has been sometimes drawn, that such want of knowledge is simply a private matter. It is," as Sir Henry goes on to say, and very justly, "a national loss, the amount of capital thoroughly wasted, and which, if rightly employed, would have been beneficial to the public, is enormous."

As he would have the public better informed than it is on these subjects, he would have the miner, particularly in the coal district, better instructed than he is. Colliery explosions call forth his remarks on this topic:—"Much good," he says, "may no doubt arise from the appointment of inspectors of collieries in the different districts in this country; but the more effective saving of life from colliery explosions must be looked for in the instruction, generally, of the coal miners themselves. The amount of mischief arising from the foolhardiness of ignorance in our collieries can only be credited by those who are compelled to employ men with a want of education they deplore."

Sir Henry refers us to the following interesting practical results which have already taken place from the Exhibition:—

"As relating to the ventillation of collieries, a model of opening and closing the doors in them, by the passage of the horses and waggons, or of the men, without the attendance of boys or others for the purpose, had very important bearings, so many accidents having occurred from the ventilation being disarranged by leaving open such doors. It was a good case of a valuable contrivance, apparently little known beyond the colliery itself—the Foxhole Colliery, near Swansea—being made more extensively so by means of the Exhibition.

"In this collection was a most remarkable example of the fine rolling of iron, the latter itself being necessarily of excellent quality. The "iron paper," as it was termed, from Neudeck, in Bohemia, was superior to all of its kind in the Exhibition. * * * It soon attracted the attention of those skilled in iron, as such thin rolled iron is important for button-making. A spirited party, connected with the iron trade, at once proposed, in a proper quarter, to imitate this Bohemian product. This was attempted, and though the result was not quite equal to the original, before the Exhibition closed thin rolled iron of a quality not heretofore produced in this country was to be had in the market."

Some other pleasing results are also alluded to, and many more, placed but as yet in the perspective. Sir Henry de la Beche, however, on the whole, considers that the Exhibition was deficient in many matters relating to the subject. The greater knowledge attained, the more readily, it is obvious, must such deficiencies be observed. But there, fortunately, is at hand the power and the will to show how they may be supplied:—

"As regards mineral raw materials, mining and metallurgical processes, the Exhibition was of a very unequal character. While there may have been many deficiencies, there were, at the same time, many important illustrations of this class. Regarding the subject as a whole, we have to repeat what has already been said of a particular branch of it, that the marvel is how, under all the conditions of collection, so much that was effective could have been accomplished. It is most desirable that the real character of this portion of the Exhibition, as, indeed, of all others, should be thoroughly understood, alike for the benefit of present knowledge as for future progress. Depreciation or exaggeration, the one by reaction usually producing the other, have to be alike avoided. By analysing the truth, we obtain results such as may really produce advance, and advance is your object. The Great Exhibition, brilliant as its course has been, is not the end; it is the means to the end. You do not intend to stand still, and look back upon its past splendour as a thing only of history; you propose to consider how far you can render it available for future public good."

We cannot close this article without smiling for a moment at the date of the delivery of the lecture—December 2, 1851. How differently was attention aroused in the quiet meeting in the venerable Society of Arts and elsewhere!

RAILWAY MACHINERY: A TREATISE ON THE MECHANICAL ENGINEERING OF RAILWAYS, EMBRACING THE PRINCIPLES AND CONSTRUCTION OF ROLLING AND FIXED PLANT, IN ALL ITS DEPARTMENTS. By DANIEL KINNEAR CLARK, Engineer. Parts I.—VII. Blackie & Son.

(*Second Notice.*)

In passing from the historical to the practical matter of this suggestive work, in fulfilment of our promise of December last, it is difficult to avoid pausing on the pages devoted to the progressive evolution of the presently admitted systems of valve-gear, if only to express our satisfaction with the luminous and complete exposition which they afford of the settlement of that most important problem. Every mechanic, at all conversant with the development of the locomotive, knows how earnestly schemes, pretending to a complete solution, were put forth and discussed in the apprentice period scarcely yet expired; how the aim enlarged from day to day, from a simple maintenance of the lead of the valve both ways, to the obtaining of a complete reversing system of expansive gear of easy construction and management; and removing the goal yet further, how this object has been attempted with a single eccentric, and not altogether without success. All these steps towards the realization of the ultimate idea, are pregnant passages in the technical history of the locomotive, which Mr. Clark has afforded us the means of fully appreciating.

We turn, however, to the subject-matter of valve-motions, as finally approved and established; and here we find ourselves upon ground, for the first time, systematically examined in its full breadth by a diallist thoroughly competent to the work. In France, where the literature of the arts is always in advance of the practice, so broad a statement could not, indeed, be made without some explanatory abatement; but, on this side of the Channel, it would be difficult to find anything upon which to found a limiting clause. This state of matters does not, and it would be humiliating if it did, argue a like deficiency of technical knowledge, or, indeed, the knowledge of principles, possessed by our home-engineers. On the contrary, in no department of human activity has knowledge grown up and spread more rapidly, than in railway engineering. Throughout the profession, the most laudable ambition has existed to initiate and work out improvements, and with a success of which we are nationally proud. Something of this rapid growth is, no doubt, due to the external stimulation which the profession was subjected to during the Glenmutchkin period: the unparalleled magnitude of the resources thrown open to it in the delirium of public fever, and the consequently elevating practice in which the first years of apprenticeship were passed. The reaction came, and consolidation of experience and order have followed the excitement. The advantages of a judicious subdivision of functions have been kept at least partially in view. Every railway has its reflective, as well as its merely operative organization: perhaps too much diffused and divided to secure the full advantages of a concentrated application of the respective energies, within the very moderate area which a single mind, of fair average extension, can occupy without distraction.

But our subject is valve-motions, not general economy; and we meant to have said, before going astray, that although Mr. Clark has produced the first and only systematic exposition of the long-discussed systems of lap and lead available to the English mechanic, he has not, and does

not pretend to have, created the knowledge he places before us. On the contrary, there has long been accumulating a large stock of most valuable information relating to all the vital questions of locomotive economy, fragmentary and loose, but available for good use by whoever could sift it and reduce it to order. This Mr. Clark has done. He found ready to his hand a large stock of facts, much workmanlike knowledge of principles, even some good formulæ, all ready made, and resting on the broad basis of an active and watchful experience, extending through much variety and modification of opinion. He entered, in fact, on his self-imposed task with the whole stock-in-trade of the locomotive engineer under his control, and he has shown that it was not misplaced —that he knew how to turn it to good account. What had hitherto been a matter of faith and tradition, he has reduced to a positive and permanent form; and has eked out the looser data of aggregate experience, by new and more precise investigations. He has seen what was wanting to complete the systematic development of the principles involved, and set about completing the researches. The general result is a very successful elucidation of the subject. The often-conned action of lap and lead of the valve, and the capabilities of working with varying degrees of expansion by varying the travel, are among the questions analysed and reduced to their elements; and by showing what is the effect of each separately, the whole doctrine is placed within the reach of any tyro to settle the proportions of the valve-gear of a locomotive for himself, and to foretell what would follow from a change of existing conditions.

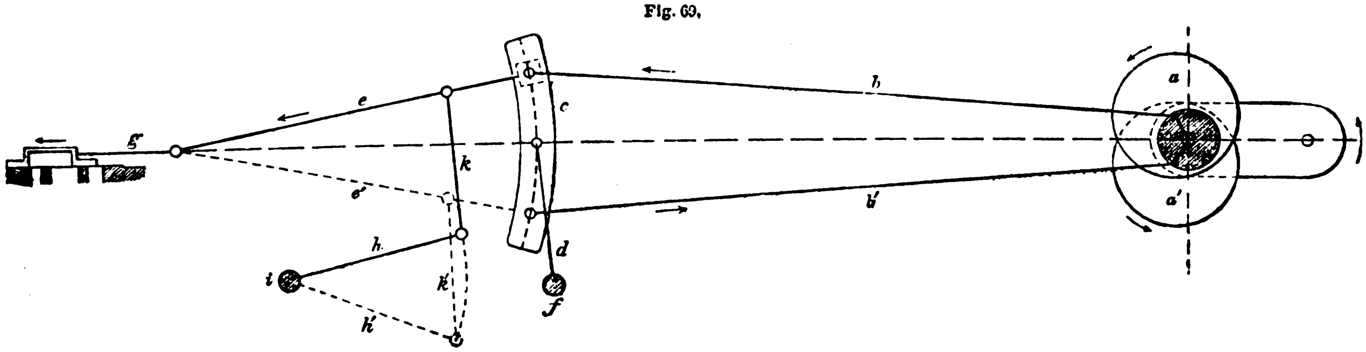
The still more recondite systems of link-motion are also handled with skill; and the peculiar difficulty usually supposed to beset the treatment of this subject, owing to the want of fixed points to work from, illustrates Mr. Clark's tact in treating complicated questions in a workmanlike style, as happily perhaps as any section of his work yet published. His proof of the identity of action of the link-motion with a single eccentric, is an apt example. We quote the proposition:—"The compound motion of two eccentrics transmitted through a correct link-motion, is essentially the same as that of a single eccentric (the valve) having the same lap, lead, and variable travel." This is a felicitous conclusion, as it affords the ready means of calculating tables of the action of link-motions, in all varieties and phases, directly from the simple relation of the crank and a single eccentric, by which we may assume the valve to be wrought.

The following is the preliminary part of the analysis from which this conclusion is derived; besides being in itself important, it affords a very fair example of the general mode of treatment of such questions:—

INVESTIGATION OF THE LINK-MOTION.

Our normal or fundamental pattern of link-motion shall consist of a stationary box-link, sustained from below, with a pair of moveable sliding-blocks, which shall, in the following discussion, be considered as one. The block shall be hung on one end of the valve-rod link, and shall be shifted by means of the reversing lever linked to the body of the valve-rod link. With the aid of the annexed centre-line drawing of the motion now referred to, the following definitions may be premised. The valve and the valve-face are supposed to be turned about the valve-rod, as to be represented in section.

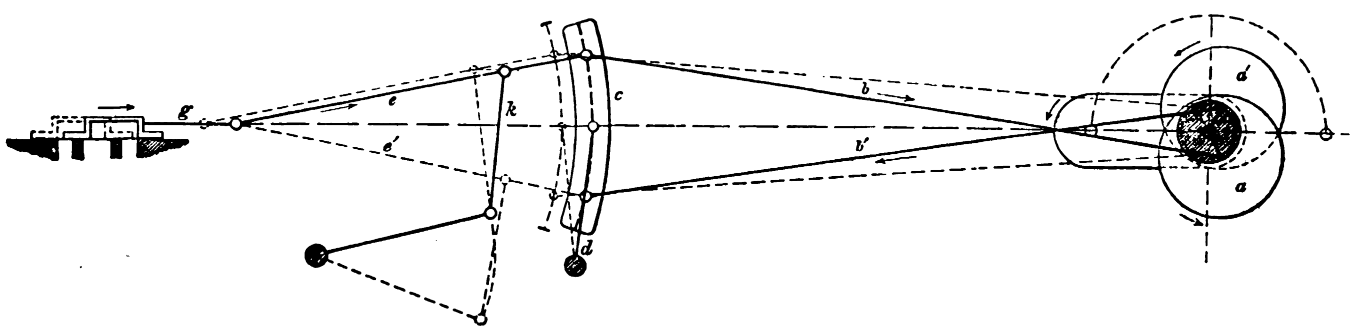
Fig. 69.



Stationary link-motion (normal) in full gear forward for beginning of back-stroke.

Definitions (abridged).—Fore-eccentric, *a*; back-eccentric, *a'*; corresponding rods, *b* and *b'*; the link, *c*, and the *sustaining-link*, *d*; (when the shaft, *f*, is above the link, *c*, the link, *d*, is called the *suspending-link*); the link, *e*, proceeding from the valve-rod, *g*, to the link, *c*, is the *radius-link*, or the valve-rod link; the reversing-lever, *h*, is keyed on the reversing-shaft, the link, *k*, is the *reversing-link*, connecting the valve-rod link with the reversing-lever—its function is to shift and sustain in the required position the valve-rod link. In the figure, the valve-rod link is shown in full gear with the fore-eccentric rod, and the dotted lines, *e'*, *k'*, *h'*, indicate the position of the reversing mechanism in full gear backwards.

Fig. 70.



Stationary link-motion in full gear forward for the beginning of the front-stroke.

The *front-stroke* of the piston is that which is described from the front end of the cylinder towards the crank; and the *back-stroke* is that described from the back end of the cylinder towards the front, or *from* the crank.

The principal dimensions affecting the distribution of the steam are in inches, as follow:—Lap of valve = 1; lead = 5-16; throw of eccentric = 4½; length of each eccentric-rod = 54; of link between the ends of eccentric-rods = 12; of sustaining-link = 12 (attached to the link at the middle of its length, and on the centre-line); of valve-rod link = 30, betwixt end centres; of reversing-link = 12 (attached to the valve-rod link at 7 inches from the centre of the block); of reversing-lever = 15; and of valve-rod, unimportant.

The mechanism of the link-motion before us is divisible into two distinct sections—the eccentrics, eccentric-rods, and the link, with its subsidiary sustaining-link, form one system, the motion of which is constant and unchangeable. On the other hand, the valve, valve-rod, and valve-rod link, derive their motion from the link; and the quality of this motion is dependent upon the position of the block in the link, a position assigned to it by the reversing-lever. The motion of the valve is therefore derived entirely from the link, and is controlled by the reversing-lever.

The obtainment of variable expansion is effected in the link-motion by varying the travel of the valve. This mode of varying the admission has already been exemplified in the motion of a single eccentric. The motion yielded by the link is apparently not of so simple a character; throughout the whole length of the link, it is compounded of the motions imparted separately by the eccentrics, excepting only at the points where it joins the eccentric-rods. Though motion of every other point of the link is so compounded, the motion of each eccentric, nevertheless, predominates in its own half of the link above and below the centre of suspension, and results in a motion communicated to the valve, of which each reciprocation has a varying velocity, accelerated and retarded like that yielded by the single eccentric. With respect to the variability of the travel of the valve, a condition which has just been alluded to as the means of working expansively, it is obtained by shifting the block towards the centre link—in this case the centre of suspension. No point of the

link, it is true, is permitted to remain stationary, as one or the other eccentric-rod is constantly on the move. The least horizontal change of the link, however, takes place at the centre, and the difference of the travel derivable from that point, and from the neighbourhood of the eccentric-rod, is considerable enough to give precision to the expanding functions of the link.

But while the practicability of variable expansion by means of the link is thus established, a condition necessary to its most successful operation is the preservation of a constant lead for all degrees of expansion, implying, of course, that the valve should, at the commencement of the stroke, occupy the same position on the valve-face, and have the same opening of the port for steam, whatever may be the total travel assigned to it through the reversing mechanism. This condition is simply met by forming the link as a segment of a circle to the radius of the valve-rod link. Referring to the foregoing figure, the eccentrics are set on the axle with the same linear advance, and it follows that, when the crank is at the beginning of its throw, as in the figure, which is the critical period now contemplated, the centres of the eccentrics are in the same vertical line, and are equally distant from the horizontal line. Also, the eccentric rods are of one length, and are attached to the links at equal distances from its centre, which is in the horizontal line. The ends of these rods must, therefore, like the other extremities, be in one vertical line; and if the link be formed circularly to the radius of the valve-rod link, it follows that the block may sweep the entire link from end to end, while the valve and valve-rod remain perfectly at rest. It appears, then, that by the simple device of circling the link specially to the radius of the valve-rod link, the lead imposed upon the valve, when the block is in full gear, is preserved unaltered when the block is shifted into any other position.

Again, supposing the crank to have accomplished a half revolution, it returns into the horizontal line diametrically opposite to its former position (as in fig. 70), in readiness for the commencement of the front-stroke. The eccentrics also have described a half revolution, and their centres similarly are on the opposite sides of their paths. So inverted, with their linear advance situated on the opposite side of the vertical line, the link has been removed at both of its ends from its first position, by as much, at least, as twice this linear advance. Also, the removal at both ends is equal, for the angularity of the eccentric-rods, though they are now crossed, is the same. The removal is, in fact, a small quantity more than twice the linear advance of the eccentrics, due to the greater obliquity of the rods, their deviation from the first position being indicated by dot-lines. Thus the link occupies a new position parallel to its first, and the valve-rod link, which still vibrates on the horizontal line, is removed with it, and the block may sweep the link as before, while the valve remains stationary. The new position of the valve is such as to yield the same lead for the front-stroke that was found for the back-stroke. The space through which it travels for this purpose is indicated by the figure, and is equal to that described by the link. It is, in short, twice the linear advance of the valve; and as the horizontal removal of the link slightly exceeds the double of the linear advance of the eccentrics, the linear advance of the valve must also be something greater than that of the eccentrics.

With these premises, the author proceeds to develop his method of setting the eccentrics for the stationary link-motion; and the value of a general method of doing this is the greater, insomuch as every modification of dimension and arrangement requires a distinct setting. There are several known ways of approximating to the true set of the eccentrics by trial and failure; but that recommended by Mr. Clark is, we believe, new, and it is certainly simple and direct.

The author's next step is to the consideration of the shifting-link, and the influence which the various modes of suspending the link have on the action of the valve. These, together with the influence of the connecting-rod, are points too frequently overlooked even by those who ought to have a full appreciation of their importance. It is not, indeed, uncommmon to hear attention to such details scoffed at, as implying a degree of precision altogether beneath the notice of any but a theorician. It is, accordingly, quite commonly to be observed in the working of the engines of those lines where the engineers are more particularly strong in their empiricism, that there is a painful want of uniformity in the beat of the engines. Instead of the engine making, as it ought, in the course of a revolution, four distinct and equal discharges of exhaust-steam, in very many cases the two discharges from the front ends of the cylinders are perceptibly much the stronger; so that, at high speeds, one of the discharges is slurred; and, in the phraseology of the driver, the engine has only three exhausts. It might be troublesome—at least tedious—to demonstrate to the case-hardened empiricist, that this inequality of the beat is attended with any mal-influence—which, in his mind, means increased consumption of coke, and nothing more; but there does not seem to us a doubt, that it aggravates any cause of unsteadiness with which an engine may independently be affected; and it needs no proof, that whatever tends to promote the irregularity of the motion of an engine, simultaneously tends to increase the repair account. And from this point we might reason backwards, and find that more coke is required to sustain the increased fatigue by which repair is hastened, than when the work of damage is avoided. It is, therefore, with satisfaction that we find Mr. Clark devoting considerable space to the examination of the conditions necessary to be observed, for securing equal induction to the front and back strokes—which means equal beat; and pointing out the means of remedying the fault where it actually exists.

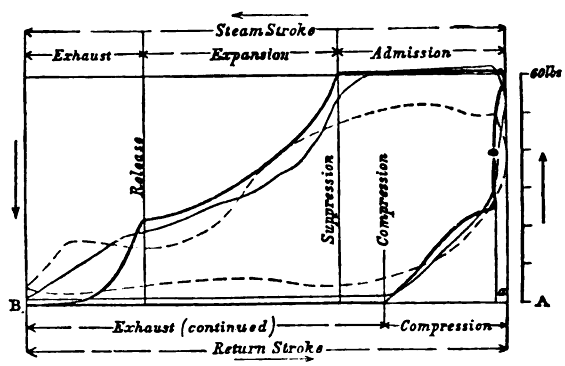
A still more important department of Mr. Clark's investigations is devoted to the mechanical action of the steam in the cylinder. The inquiries on this subject have been prosecuted most extensively with the aid of the indicator. It would be premature to pass conclusive judgment on the results deduced from the data thus obtained, as the entire discussion is not yet published; but we have no hesitation in commending this, the only really practical mode of examining the *modus operandi* of an engine, of verifying the geometrical relations involved in its construction, and of discovering in what way and to what extent they are influenced by inequalities of temperature, pressure, play of joints, and the like. Nor have we any hesitation in believing, that if his management of the experimental part is as searchingly conducted as his *à priori* investigations concerning the valve-gear, he will open up a field of inquiry of far greater extent and of far more vital importance, as regards the economical employment of the steam, than any over which he has yet passed, It is only by means of the indicator that a general integral of all the influences can possibly be obtained, where so many of them are still so indifferently known and appreciated; and we have some confidence, from the specimen before us, that Mr. Clark fully appreciates it as every engineer ought.

The following figure and extract from this section of the work, will serve to explain the terms which the author makes use of in this part of his inquiry. On this subject of terminology, we are, in some measure, at issue with Mr. Clark. Where terms are already established, even if they are not the most expressive or appropriate, it appears to us better to retain them than to adopt others; and in enlarging a definition, especial care ought surely to be had, not to falsify the signification which has already been established—as is done in the case of the term *lead*, for which *advance* is a tame substitute. Nothing has, moreover, been saved by way of brevity, by restricting the old term to "the width of opening of the steam-ports for the admission, or for the release of steam at the beginning of the stroke;" for it is still necessary to indicate what particular *lead* is meant, whether lead of induction or of exhaust; or, according to Mr. Clark's nomenclature, whether it is outside or inside lead. There is, certainly, better reason for the introduction of the terms *suppression* and *release*, which are defined by the following diagram, as the points to which they apply could previously be named only by a circumlocution; and we admit, that, in technical language, brevity is always to be courted. Again, to balance *admission*, it might be urged that we ought to have had *exhaustion*, not *exhaust*, to denote the period during which the steam is escaping from the cylinder, leaving us *exhaust* to express generally the state of the cylinder as to back pressure—to enable us to say that the *exhaust* is good or bad, quick or otherwise. Authors, however, have long claimed and been allowed the privilege of defining their terms according to their own particular views; and if the right is granted to one, it can scarcely be denied to another: on this ground, we have no doubt, Mr. Clark takes his stand.

The following is the extract which led us into this digression:—

The dark-line diagram, fig. 95, was obtained from the cylinder of a locomotive of 20 inch stroke, while moving at 2½ miles an hour. It indicates very distinctly the nature of the distribution in the special case, and graphically displays the behaviour of the steam under the influence of the valve. The piston is represented as moving under a uniform pressure of steam of 61 lbs. till it reaches the point of suppression. The admission being terminated, the expansion of the steam * * commences,

Fig. 95.



General illustration of the behaviour of steam in the cylinder relative to the successive periods of the distribution.

and is plainly indicated by a sudden fall of the curve, intimating a rapid reduction of the pressure as the piston moves on. The progressive reduction of the pressure throughout the whole period of expansion is demonstrated by the continual depression of the curve, which falls steadily until the piston reaches the point of release At this point a second change takes place, and the piston enters upon the third and last stage of its progress towards the termination of the steam-stroke. The period of exhaust commences while yet the piston is considerably short of the end of the stroke; the curve breaks at the instant of release: the steam which was previously

admitted at 61 lbs. pressure, and attenuated to 23 lbs. pressure previously to its being released, quickly discharges itself in virtue of its remaining elasticity, and is entirely evacuated even before the piston has finished the stroke. The complete evacuation of the steam is proved by the merging of the curve into the datum line, and its coinciding with it, finishing in a mere point of no-pressure at the end of the steam-stroke. But though the indicated pressure of the steam at this point is nothing, it intimates simply that the elastic force of the steam is reduced to an equality with that of the atmosphere. The evacuation is therefore only relative. * * On this account it is clear, that the business of the exhaust is by no means completed, even when the pressure has been reduced to nothing; the exhaust-port ought to be kept continually open to the face of the piston * * throughout the whole of the return-stroke: and the benefit of this provision is proved by the diagram, for it appears that, during the continuation of the exhaust, the steam pressure remains at zero, and therefore insensible to the indicator. At the instant of closing or compression, when there is no longer an exit for the steam before the advancing piston, the diagram-line starts upwards towards the right; the steam hitherto insensible, and finding no way of escape, is compressed against the end of the cylinder into a space which continually grows less as the piston advances. While the volume of the confined steam is being thus forcibly reduced, its density is increased, and its pressure proportionally rises; and the accumulation of back-pressure so induced, is promoted till near the end of the return-stroke, when it becomes lost in the superior pressure of the steam admitted by anticipation for the business of the next steam-stroke. The critical point at which this interruption of the gradual compression occurs, is indicated by the small compartment, *a* (in the figure), representing the *period of pre-admission* (which, in the old vocabulary, means the "lead of induction"). The curve starts upwards at the instant the valve opens the steam-port for the admission of steam from the valve-chest, and reaches the initial pressure of 61 lbs. for the commencement of the next stroke.

Omitting the remaining part of this development, and the reference of the points of the elementary diagram to different positions of the valve gear, we make room for the following remarks on the influence which the velocity of the engine has on the steam diagram, as exemplified by the same figure:—

The two diagrams in light and dotted lines, were taken at speeds of 20 and 44 miles per hour, respectively, from the engine with which the slow diagram was made, the points of distribution being, in all the cases, identical. There is therefore nothing to observe but the effect of speed; and in the first place, the steam, though admitted with an initial pressure of 62 lbs. in the case of the slow speed, slightly looses its force as the piston recedes before it—a circumstance which may at once be attributed to the accelerating speed of the piston in the cylinder, and the consequently greater difficulty of following it. The difficulty is, however, but small, and it is only when the piston nears the point of suppression, and the opening of the port for steam approaches to nothing, that the pressure rapidly falls. This is a case of simple wire-drawing, as the opening of the port, previously large enough to admit all the steam that could find its way through, against the frictional resistance of the passage, now arrives at the minimum width consistent with this condition, and a further contraction, and final closing, necessarily occasions an accelerated fall of the pressure. The pressure at the instant of suppression, under these circumstances, is 54 lbs. The curve descends during the period of expansion, and cuts the line of release at a pressure of 19 lbs., and on reaching the end of the stroke, it attains a minimum of 2 lbs. pressure. The curve of expansion runs into those of the admission and the exhaust, without the abruptness which distinguishes the slow diagram. The truth is, that before the steam was nominally suppressed, expansion had begun—a result necessarily implied in the idea of wire-drawing. The curve, nevertheless, rapidly alters its course, after crossing the suppression line. At the other end of the expansion, the curve crosses the exhaust line, nearly at right angles, and barely reaches the minimum pressure at the termination of the stroke. The comparative delay so evinced in the accomplishment of the exhaust, is plainly a consequence of the shorter time allowed for this purpose by the greater speed of the piston; and accordingly we find a considerable accession to the useful effect of the steam in the very circumstance that it exhausts less freely. On the other hand, a drawback to this effect exists in the continued back pressure of 2 lbs. during the return-stroke, referrible to the same imperfect exhaust. The curve of the exhaust, during the return-stroke, joins the compression curve with a slight bend; and it is observable, that before the pre-admission takes place, the compressed steam attains a final pressure higher than that found by the slow diagram—a circumstance referrible to the greater condensation of steam in the cylinder, which accompanies very slow speeds, and which is consequent on a reduced mean temperature. But though the curve of high speed is in advance of that of the slow diagram at the point of admission, it falls behind it at the commencement of the stroke, as at this point the pressure does not get beyond 51 lbs., and only attains the maximum of 62 lbs., when the piston has described half an inch of the steam-stroke. This delay is chiefly attributable to the insufficiency of the time allowed for the re establishment of the working pressure, by the speedy motion of the piston, and by insufficient lead.

The diagram in dotted line affords a still more marked example of the irregularities produced in the figure at high speeds.

In this instance, the speed is 44 miles an hour, more than twice that which existed in the previous instance, and the diagram nowhere appears to be a straight line. We observe that the maximum pressure (52 lbs.), during admission, is not attained till the piston has described 4 inches of the stroke. From the same point, it falls towards the suppression line, which it crosses at a pressure of 47 lbs., and describing an ogee wave line during the expansion, it crosses the release line at a pressure of 15 lbs., and terminates the stroke at 5 lbs., after rebounding to the height of 17 lbs. With all these irregularities, there is no doubt that the inertia of the reciprocating parts of the indicator has much to do. The first disturbance takes place at the point of suppression, and it may be granted that the wire-drawing which precedes the suppression is not fully indicated; that, in fact, the indicator barely follows the pressure of the steam with sufficient celerity.

Mr. Clark follows out this hypothesis very conclusively, but allows, and, indeed, maintains the probability, that some part of the irregularity is due to internal agitation of the steam in the cylinder. We would willingly have followed out this investigation, but our space is already more than overdrawn.

Since writing thus far, we have received another portion of the work (Part 7), in which we find the subject of the saltatory movements of the indicator still more closely examined, and mainly—almost demonstratively—attributed to the pulsations of the steam in the cylinder. All the other influencing circumstances—clearance, lead, water in the cylinder —are examined separately, and a convenient summary is given of the conclusions arrived at in the investigation. The succeeding chapter is that, however, which the engineer will most value; it is devoted to the examination of the action of the steam during expansion. The title of one table, that occupying page 80, gives alone some notion of the points sought to be established. It is "The water Equivalents of Steam obtained from Diagrams taken from the 'Great Britain' locomotive." This table alone exhibits the information contained in upwards of fifty diagrams on the particular question to which it relates. But we must proceed no further. The space we have occupied, is some indication of the value we place on Mr. Clark's labours. The work, so far as published, is very much in advance of any other publication of the kind that has gone before it, both as regards originality, breadth, and clearness of treatment; and we have some confidence that the zeal—perhaps we ought to say the enthusiasm—which carried the author so successfully through the years of experimental and preparatory labour, which must have altogether preceded the publication of any part of such a work, will not have failed in the portion which is yet to come. Such a work, indeed, could be produced only under the heat of enthusiasm, backed by a hale and energetic constitution; for under no other conditions could the seemingly inexhaustible stock of data which the author has at command, have been accumulated. We have no need to recommend the work—it recommends itself more effectually than we can. But we may fairly add, that if the work proceeds throughout as it has hitherto done, it will finally confer no small benefit on the profession.

Report of William Lee, Esq., C.E., to the General Board of Health, on a Preliminary Inquiry into the Sewerage, Drainage, and Supply of Water, and the Sanatory Condition of the Inhabitants of the Township of Poulton, Bare, and Torrisholme, in the County of Lancaster. H. M. Stationery Office, London, 1851, p.p. 25; Maps.

In our recent notice of the sanatory measures which are being adopted at Liverpool (see our last number, p. 229, &c.), we entered at length upon the subject, which is of the last importance in populous places. It is, however, obvious, on the slightest reflection, that the matter claims equal, if not greater attention, when it relates to smaller localities; for these smaller districts, in the aggregate, comprise a larger population than all the great manufacturing towns put together. We are glad to find many of the lesser rural districts grasping at the means offered to them by the Public Health Act, of bettering their sanatory condition. Among these is the little well known spot to which the above report relates.

Aroused by many of the circumstances, which we shall presently shortly pass in review, it seems that an inquiry into the sanatory conditions of this rising neighbourhood was entered upon at the commencement of last year. This inquiry was excited on the exhibition of the following facts. The township includes upwards of 1,700 acres, and comprises the three separate hamlets of Poulton, Bare, and Torrisholme —Poulton, the most distant, being but three miles west from Lancaster. Its increasing importance as a suburb of that ancient manufacturing place is shown by the following statistics:—

In 1801, the population numbered 423; in 1811, 488; and in 1821, 615; while, in 1831, there were 147 houses, and 838 inhabitants; in 1841, 184 houses, and 1037 inhabitants; and in 1851, the houses amounted to 259, and the dwellers in them to 1,301. The increase of inhabitants, however, must be considered as still greater, when it is borne in mind, that in the last year the census was taken in March, the most unfavourable season, and formerly, it was taken in June, when the inhabitants always amount to a greater number.

Nearly the whole township lies very flat, being in winter often under water. Indeed, "a bank has been formed in certain places along the shore, to protect the land from incursions of the sea during high tides and storms." When drained, the meadows are found to be good, and the arable land produces good crops of wheat. This drainage is, however, wholly on the surface, and in many places the water is "left to stagnate in pools and putrid masses." The inhabitants are chiefly agri-

cultural, and employed in fishing; and the manner of carrying on the latter is very prejudicial to sanatory condition. Many of the better houses have no pavement, approach, or drainage, and close to the bedroom windows, both in front and at back, are deposited large heaps of manure, small fish, shrimps, and other shell-fish, where they are left to putrefy. The evidence of one cottager says—"*The house is damp, and the water has come in and flowed over the floor; myself and child have had fever, and two people next door were ill at the same time.*" Besides this, many of the houses are without out-buildings, yards, or privies; and, of course, all the filth and *excreta* are thrown into the streets. "The filthy state of the township" seems to have made it be considered as "one of the most neglected and dirty villages in the neighbourhood of Lancaster." "Every thing," says one witness, "stinks in hot weather;" and it is repeated by others, that the "stench is so great as to be perceptible at a distance of a quarter of a mile." "It is a common complaint that persons can neither go this way, nor that way, without encountering bad smells." Among these it is stated that "the smell of decaying shrimps is peculiarly offensive, and one that can scarcely be imagined except by those who have experienced it." It is not to be wondered at, therefore, that typhus and other fevers are prevalent. Even at Torrisholme, the farthest from the coast, the atmosphere is alleged to be "impregnated with the most offensive odours," arising from the deposits before mentioned, including seaweed, placed between the high land and the shore. Efficient means of drainage have lately been suggested, and as it is estimated that the cost will not exceed 1d. per week for a cottage, besides the probability of even this being reduced by the sale of portable manure, it is likely to be carried out. The supply of water, too, and that of a bad quality, is very short. "Some of the people are compelled to come nearly a quarter of a mile to the public pump." Mr. Lee has given this important matter his best consideration, and estimates that the township "might have a constant supply of pure water, under pressure, at a price not exceeding the maximum fixed by the Public Health Act, namely, 2d. per house per week." The state of the roads is another subject which, from a peculiar system adopted by the separate surveyors of the hamlets, not united for the purpose, is fraught with increasing evil.

To Dr. James Johnson, of Greenfield, who is intimately acquainted with the locality, the superintending inspector, who has furnished the Report, expresses himself much indebted for information on the inquiry; and we can repeat with Mr. Lee, that the Doctor's "statements and opinions are exceedingly interesting, not only from their illustrating the present condition of the township, but also because of their important bearing upon its prospective condition as a place of resort by those who are seeking health." This medical gentleman speaks as follows:—

"I reside at Greenfield, Lancaster, and at the same time occupy a cottage at Poulton. I lived at Bare Hall during three years, commencing April 1845. I have found this climate beneficial, upon the whole, to my family; but I have known several times the common epidemic diseases of infancy to run a very fatal course here among the children of the poor, in damp situations, exposed to effluvia from open, wet middensteads, heaps of decaying fish, &c.

"Persons coming here for their health (and ultimately deriving benefit from their visit), are often, for the first few days, strangely affected in the bowels; sometimes by diarrhœa, more frequently by constipation—a state of things commonly attributed to the water, which is generally at Poulton hard, and often brackish.

"When residing at Bare Hall, my family was remarkably healthy, with the exception of one individual, who was somewhat bilious, and showed a frequent though slight tendency to ague. But a low description of fever prevailed for twelve or eighteen months in the village, and carried off four or five persons out of twenty who were attacked. My man-servant and his wife died of it, and, after great resistance, I at last prevailed on their family, as they were attacked, to go into the excellent infirmary of the town of Lancaster; and by this means, at length, the chain was broken. Ague, though not very prevalent, is sufficiently common in the district for the poor people to be able to diagnose the disease of their own sagacity, and to know something of its nature and laws.

"I do not know whether it arises from the indifferent character of the water, a want of tone in the stomach, or the sedative effect of the climate, or from some other cause, but certainly there are very few water drinkers in the parish. A want of some stimulant is generally felt, and the moderate use of stimulants is apparently advantageous.

"Invalids, in suitable cases, generally derive renewed health from a visit to Poulton. The winter is very mild, with little frost, but, during the few weeks of spring, when the dry east wind sets in from the land, there is much bronchitis, and general benumbing, as it seems, of the powers of life amongst invalids.

"Although the air is, on the whole, mild, moist, and equable in temperature, yet at the equinoxes, and after the solstices, when a change between the land and sea breezes takes place, there are, for a short time, some great and sudden vicissitudes. These, I believe, are found to be promoters of zymotics, and I should say that the north-west coast of England may be, like Ireland, rather exposed to that class of diseases, from atmospheric laws, to a certain extent beyond our control. Hence the great necessity of mitigating that which we may not wholly prevent. The evaporations from open ditches, and wet reeking heaps of manure, should be guarded against. Wet miry roads produce more disease amongst delicate people, and even amongst cattle, than is generally admitted."

No doubt, the poor have cause to complain, as they do complain, of these nuisances; and it is further characteristic of the very bad state of things that at present exists, that many of them are loud in their call for remedial measures. We cannot be surprised at this when the enormous comparative mortality of their children is noticed. It is stated that "the average age at death of all who are born is only 25 years for fishermen *and their families*, while the average age at death of adults of the class fishermen is 52 years." Sometimes infantile epidemics of various import occur, such as that in 1839, when the number of burials in the previous year was quadrupled. It has, indeed, been ascertained that the poor live longer in Lancaster than in this rural district. They, however, appear to convert to profit *one* of the causes of the state of things above linked together. For, by a liberal use of manure, they often obtain two crops—it is not, however, stated of what kind of produce—in one year, and are able to dispense with the regular rotation of crops altogether. The value of manure, thus made sensible, has induced a project for imitating other places, and collecting the drainage in a receiving tank for agricultural purposes.

The railway running through the township, and, indeed, "several hundred yards into Morecambe Bay, by means of a handsome timber jetty," is calculated, from the nearness of Lancaster, to make one presume that a large trade will be carried on here at no distant period, and Poulton and the new town of Morecambe, which is now in course of erection, may become a respectable seaport town, brigs being able to discharge their cargoes at once into the railway waggons. We trust that, as suggested by Mr. Lee, the measures taken with regard to this new suburb of Lancaster will be to *avoid* what, in the old places, has to be now, and is likely to be soon, *remedied.*

Poulton, or "Poulton-on-the-Sands," as it is more commonly called, has been for long past a favourite resort by the inhabitants of West Yorkshire, particularly for sea-bathing, as well as a quiet retreat to the merchants and manufacturers of Lancaster; and we hope that the recommendation by Mr. Lee will be acted upon, in the benefits of the Public Health Act being applied to the township. Mr. Lee sums up these benefits as follows:—

"That the health of the inhabitants would be much improved by proper supplies of water; improved drainage of the land, and of the courts, houses, and other buildings; the remodelling of privies; the removal and prevention of all accumulations of offensive matter, and other nuisances; the improvement and systematic drainage of the public roads, and the pavement of private premises; and regular and systematic surface cleansing."

We trust to hear of the example thus afforded by this small locality, of deliberately and fearlessly investigating into its own circumstances, being followed generally throughout the country. It is not, of course, possible to know the whole ulterior advantage arising from so doing, but it is certain that the present generation *must* be benefited, to an extent, in some things, the value of which can be estimated only by those who have been compelled to live against their will in a state of filth and disease. In these matters, to inquire is to know, and to know is to improve.

CORRESPONDENCE.

THE PORTUGUESE EXHIBITION OF 1851-2.

The object of this exhibition, which is just now open, is less the comparison and reward of works of industry, than the raising of money for a charitable fund. It is common in Lisbon to raise money for these purposes by lotteries, and in the present case, every one receives a lottery ticket in exchange for his admittance fee, which amounts to 3d. Whether the prizes will be in money or in works of art, I do not know.

The subjoined enumeration of some of the most remarkable objects exhibited, comprises Portuguese works principally; but where I have come across any foreign article of merit, I have thought it only fair to mention it. As your readers will probably never see the exhibition, I have not endeavoured to give such descriptions as would convey an idea of the individual forms, designs, colours, &c., of the articles exhibited; but, as far as my experience and judgment permitted, to present a sketch of the state of Portuguese arts, so far as an exhibition would enable me to do so. And here it is necessary to observe, that I did not remark any specimens of the manufactures of cotton, soap, or tobacco, all of which, with others, are protected by heavy duties, and might fairly be expected to make a considerable show. The affair, however, perhaps partakes more of the character of a bazaar than of an exhibition of industry. If you do not think my own depreciatory language sufficiently strong to give reason to question my discretion in writing at all upon the subject, the following descriptions are very much at the service of your *Journal.*

9. Eneas and Anchises. A good copy of the common picture in oil, by Senhor Teixera.

23. Painting on porcelain, or biscuit. A "menina," a little girl, apparently a servant in a religious house. There is nothing very remarkable about the subject, or the expression of the face, but the colouring is very good, and the drawing correct. By Senhora Rita de Saldanha de Gama.

28. A portrait of a young man, very lifelike, and well executed. By Senhor L. P. de Menegos.

38. A drummer, fatigued with marching, seated by the roadside. His left hand grasps the drum-sticks, and rests on the drum-head, and he is looking up into the face of a young girl, probably a "vivandière," who has given him a draught of water from a pitcher she holds in her right hand. The drawing of the figures is very good; the expression of fatigue is well given; the man sits as though he were brought to that state in which one would not care whether the regiment left him behind or not, and presses his hand on the drum-head, quite regardless of the injury he is likely to inflict upon his instrument. The drawing of the pitcher is, however, as is not unfrequently seen in similar cases, very bad. This painter has three other pictures, in two of which, the same young lady appears, almost as identical in face and dress, as if she had been printed by Baxter. The colouring is bold and rough, but of an ochreish character.

88. A vase of flowers, painted on porcelain, by C. de Chantôzeine. There are a great number of flowers, exquisitely painted, and very naturally arranged. One of the best things in the exhibition.

115. An exceedingly good picture in oil, of an old female miser, weighing her golden moidores, by our countryman, Gerhard Dow; belonging to the Duke de Palmella.

204 and 208. Landseer's well-known engravings of Peace and War; but placed in the catalogue without any intimation as to the name or country of the painter.

205. Alto relievo, the Descent from the Cross. The material looks like a white clay, the surface well polished and finished, the drawing rather mediæval.

207. A beautiful carving in ivory, being a relief upon a perforated background, resembling lace. The subject, the Annunciation to the Virgin. The figures are about 5 inches high.

284. A small vase in porphyry—a dark red-brown stone; the design simple; the body being an egg oval, and the polish very high.

285. A fine vase of Sevres china; blue, with numerous white figures in slight relief.

288. A casket, about 13 inches long, by 8 wide, and 6 high, of mother-o'-pearl outside, lined with dark tortoiseshell, with gold mountings and ornaments, which latter are very graceful, somewhat in the Louis XIV. style.

291. A tazza, of the same porphyry as the vase, 284, supported by a base and three Corinthian columns of the same material. The design is simple and elegant, and the stone well cut and polished; but it is disfigured by trumpery gilt capitals, and bases to the columns, and other ornamentation in the same incongruous material.

292 and another, are excellent models, in bronze, of equestrian statues—one of the "Imperador," Don Pedro I.

293. A curious conceit—an elephant, in ivory and gold, with an immense tower on his back, containing a clock, and I don't know how many figures for marking the hours, and so forth; and, more marvellous than all, the eyes of the elephant, which are only about eight times the proper diameter, are continually moving; but as they do not always keep together, one is reminded, every other second, of the happy modern discovery of the operation for strabismus. This curious toy was made at Goa, in 1720.

294. Seven models of vessels of war, from the "Vasco de Gama," of 80 guns, down to a revenue cutter. These models are well executed, to a scale of about $\frac{1}{20}$ inch to the foot.

300. A really wonderful piece of wood-carving, to a very small scale: a hollow wooden ball, opening in two hemispherical parts, one of which has again two semicircular doors, opening outwards. It is about $2\frac{1}{2}$ inches diameter, and besides the door mentioned being covered with carving, each hemisphere contains about thirty figures, forming a historical composition. One is the Passion on the Cross; and it is to be noted, that the figures in the background are much smaller than those in the front, so as to give the effect of distance, while every detail is perfect. The ball, if the figures were removed, would be seen to be hollowed out to leave about $\frac{1}{4}$ inch thickness of shell, so that the front figures are in complete relief, and only those at the back are in *alto relievo* on the inner surface of the ball. It is described as in the style of Albert Durer, and to have been made at Cologne in the sixteenth century.

310. The sword of Vasco de Gama, the celebrated Portuguese circumnavigator. The blade is about 4 feet 3 inches long, and the handle 14 inches. There is a kind of basket-guard for the hand, and the blade is curved in a serpentine manner, like a Malay creese.

406. The standard weights and measures of Lisbon, exhibited by the municipal council. The weights fit into each other, with fanciful handles. The measures are plain cylindrical vessels, with a handle at each side, and the arms of Portugal, all in bronze.

408. An artificial leg, by Senhor B. M. Avathe, but which will scarcely rival either the "Welsh" or "American legs" of the Crystal Palace.

410. A case containing a set of spoons, of various sizes, and one fork. The material appeared to be tinned iron, and the manufacture very rough.

432. A large aneroid barometer, by Senhor M. Vieira, but with all the inscriptions on the dial in French.

433. A portion of a dinner service in porcelain, belonging to Senhor da Costa, blue and gold upon a white ground, with the initials "J. B. A." in the centre of each piece. Very handsome, but the letters looked very like the English style of caligraphy.

446 and 447. Raw silk, produced in Portugal, apparently of very good quality.

458. A model of an engine and boilers, employed to drive saw-mills in the Arsenal. This is made in wood, in the style of a beautiful model of a pair of oscillating engines exhibited in the Crystal Palace. The engine is an old one, by Maudslay.

460. An electric telegraph; the letters of the alphabet ranged round a dial, to which a needle points.

463. A horrid model of a locomotive.

469. A sketch in pencil, and slightly tinted, of a view at Cintra. For boldness of style, combined with accuracy of detail, this is unequalled in the Exposition; the effect is also very soft and pleasing.

477, 478, and 479. Three inlaid stone tables; two from Florence, one of which has flowers and leaves, shaded, and looking very natural. Only one table, however, has the merit of consistency in the design throughout.

491 and 494. Piano-fortes, by Wagner and Habel, price £45—which is very reasonable, if they are as good as they look.

551. "Santa Philomena," a beautiful miniature figure, in ivory, of a woman reclining, and holding in her right hand a branch and a pen, and in her left an arrow.

553. The sixth and seventh volumes of the Bible of the church at Belem, very richly illuminated, and written in Latin.

615. A frame, containing six examples of proficiency in writing, attained in a course of twenty-one lessons from Senhor Vila. They are very creditable specimens, considering the number of lessons.

There is a considerable quantity of ladies' crochet and other fancy work, and some china and glass of an inferior order. In a prominent position in the middle of the room, is the table that gained a medal at the Crystal Palace; and whatever may be the general opinion of the value of the awards of the juries, this is certainly a good table. It is made of a concreted stone, with a high polish, and the design is good, though very plain.

The room in which the Exposition is held is in the Naval School in the Arsenal, and is about 220 feet long, by 65 wide, and about 35 high. The roof framing is hung with flags of all nations. At one end is a large model of a ship, apparently for the instruction of the cadets; at present, her decks are fitted with counters for refreshments. A military band was stationed at the upper end—but their music is more likely to stun the ear polite, than to sooth the savage breast. Altogether, however, it is as good an Exposition as could be expected; the worst feature is the absence of almost all specimens of useful manufactures. There is a mass of gold and jewels in the form of a cross, which reminds one of the useless glories of the Koh-i-noor. It is satisfactory to observe, amid much that is trashy and second-rate, that there are some articles exhibited with which no fault can be found, and which show taste and art of a really high order; but under their present political and religious circumstances, the Portuguese can never again become a great nation.

ALADDIN.

Lisbon, December, 1851.

LEEWAY INDICATOR FOR VESSELS.

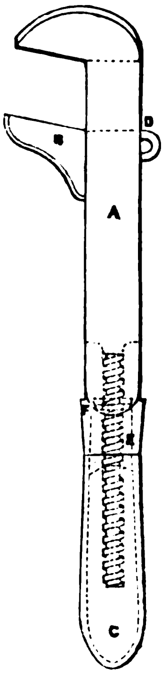
When a vessel sails near the wind, or is close-hauled, it is obvious that her motion is twofold—one direction being forward, or in a line with her keel; and the other, sideways, or at right angles to the first. The latter motion, known as leeway, is usually found by calculations, which give a mere approximation to the truth. Now, it appears to me, that the actual amount of leeway may be easily ascertained by direct mechanical means, and without any calculation whatever. To do this, I would attach a long rod, terminating at its lower extremity in a vane, to the stern post, or other convenient portion of the vessel, suitable bearings being provided to allow of the free revolution of the rod. As the vessel passes through the water, the action of the fluid will obviously

cause the vane to assume the angle offering least resistance to its motion, in relation to the two motions, which would be in the direction of a diagonal of a rectangle, whose sides are proportional to the forces engaged. The other end of the rod, being connected with an index, of course points out the angle. I am not prepared to say how far this might really answer in practice, not knowing how the vessel's motion might affect the working of the arrangement, but I throw out the idea as something suggestive.

TAU ALPHA.

January, 1852.

MACBETH'S ADJUSTABLE SCREW-KEY.



The arrangement of adjustable screw-key, represented in side elevation in my sketch, takes up no more room at the jaws than a common dead or solid key. This, you are aware, is a most important point in screwing nuts about intricate parts of machinery, where the mechanic is often excessively cramped for room in screwing, whilst he has various sizes of nuts to manage. The body, A, of the key is slotted right through to receive the slide-piece of the moveable jaw, B, which slide-piece is considerably prolonged, having the adjusting screw formed upon its end, and entered into the hollow of the handle, C. The handle is in one piece with the nut, E, which works inside the boss of the body of the key, being kept in position by a transverse pin, F, working along a ring groove outside the nut. To keep the sliding jaw, B, in its proper place, as well as to sustain the strain in working, an eye, D, is formed on the back of the slide-piece, to project through the slot in the body of the key, and through this eye is passed a transverse pin, having a flat side to work along the edges of the slot; as here shown, the adjusting screw is flattened to allow of its sliding along the narrow slot.

By this plan I obtain a very compact key, whilst the screw is completely protected from external injury, and the slot for the sliding jaw does not materially weaken the body.

JOHN MACBETH.

Burntisland, January, 1852.

LOCOMOTIVE MECHANISM IN THE GREAT EXHIBITION.

"Helix Junior" says, the more expansively you work by shortening the travel of the valve, the sooner does the port open for steam previous to the commencement of the steam stroke, *even with constant lead*. How he makes out that, with constant lead the port opens sooner, I cannot see; if he had said the suspended link gave variable lead, though in a smaller degree, than the shifting one, I could have understood him. But let us examine into this matter a little. In regard to the shifting link, when the travel of the valve is shortened, it goes slower; the port must, consequently, be opened slower, and the steam proportionally withdrawn has not the same effect on the piston as when it moves quicker. This results from the very nature of shortening the stroke. But there is another cause to be added, which retards the travel of the valve, namely, the motion of the back gear rod, and this increases with the higher degree of expansion.

Does "Helix Junior" know what an engine gets lead for? I should say not. It is found in practice that engines running at say 30 miles an hour, start away better, run easier, and burn less coke, when they have ¼ of an inch of lead, than when they have only $\frac{1}{16}$. From this, locomotive engineers argue, that at 40 or 50 miles per hour the lead ought to be increased proportionally. There cannot be any doubt that the piston will push a portion of the steam back. No one denies this; the use of lead being to impede the piston toward the end of the stroke—to be, as it were, a cushion to break its momentum, and to be ready so much sooner for its work. I cannot see any argument against lead, for the regurgitation to which "Helix Junior" alludes. The question comes simply to this—Does an engine, working at a moderate speed, work economically with a ¼ inch lead? If so, then an increase of speed necessitates an increase of lead.

"Helix Junior" says, the higher the degree of expansion, the sooner does the exhaust side of the valve close the port for the escape of steam, and, therefore, the greater the amount of steam detained and compressed; and this compressed steam (so he says) may actually exceed the pressure of steam in the boiler, and be pushed out of the cylinder. What is "Helix Junior" arguing about here?—not surely about increasing lead, but against high degrees of expansion? This is against lap altogether; which, again, in the next breath, he tells us is an elegant and efficient plan, and, further on, that engines which exhaust well in full gear, do so still better under expansion.

He says, provision for cutting off the steam equally for back and front strokes is only mere matter of detail. What a change has come over our friend! I understood him to say, this with constant lead constituted perfect action.

And now for the *sine qua non* link of Justitia's, which is at once so perfect, so complete, so easily reversed, and which lowers the boiler so very much.

When looking at it in the Great Exhibition among the many novelties there, I had no idea that anything was claimed for it except its originality—such originality, thought I, in the plenitude of my ignorance, which paints chimneys sky-blue, or turns and polishes them, drives pumps from studs in the connecting-rod, makes twin boilers, and improvises complicated links. But who, after the able letter of "Justitia," Sir, will not honour the name of Hawthorn, who has invented a link with so many advantages? Yes, honour, all honour, to him who has completed the most mechanical and the most effective reversing gear in present use, and all honour to his trumpeter, "Justitia."

I consider the Hawthorn link—First, to be one of the most expensive ever made; second, the worst to keep in repair; third, if properly made, it will not lower the boiler any; and, fourth, that the old Stephenson link is easier reversed, and the better of the two.

First, then, as to expense. I do not think any one who examines it will for one moment deny that it is the most expensive—the double jaw forgings attached to it, and the forked rod-end, with its gibs and cotters, being extra, or nearly so, to the common variable link.

Second. To those who have had the keeping of link motions in repair, this will be evident. In the ordinary link, the dies and pins wear nearly alike—that it to say, there is generally as much play in the motion through the pins getting slack as there is through wear of the links and die. The dies are commonly about three inches long, having their centre of motion in the middle; instead of which, in the Hawthorn, there is a long die, not less than eleven inches, with a hole in each end, to which the eccentric rods are attached. A provision is thus intended to be made for the dies wearing out; but will this die wear any longer than a short one? I do not think so, as it is constructed for this engine, because the rods constructed so near the ends, and working in a contrary direction, will wear the die round in the middle, and this will be more apparent when the motion communicated to the link from the radius-rods is taken into account.

But the worst feature of this motion is the great overhanging weight at the valve-spindle end. In the ordinary link, the guide-brasses, which carry the spindle, soon wear, and get out of line when there is little or no weight on them, and how much sooner they will wear when they have the weight of this heavy link and its connections to carry, I shall allow "Justitia" himself to judge, and also to calculate the number of broken valve-spindles for the first twelvemonths' wear.

Third. "Justitia" would have us believe ten inches to be a proper length between the centres of the eccentric rods, and would have us think, too, that Fairbairn & Wilson practise such gross mechanical improprieties. If Fairbairn's link is 18½ inches long, then the eccentric rods will be something like 16 inches apart, and not 10. Fairbairn's link is attached to the ends, but we may take as good authority, for the proper distance of attachment, from makers who are in the habit of using links attached so as to have their centres of motion in a straight line when in full gear. Taking Stephenson as an example, we find he makes the distance 12 inches. Now, let us see how the new link will come in with this size. First, then, we have 6 inches, and 6 inches—1½ inches (length of die above centre): ⅝ths for clearance, and 1¼th for the strength of link-top = 1 foot 3⅜th inches, or ½ inch more than Fairbairn's.

So much for my third proposition, which might be proved in another way, by supposing the Stephenson link to be the same distance between the centres as the Hawthorn's; we would then have 4½ and 4½, 1½, ⅝ths, and 1¼th = 12⅜th. The Hawthorn is 11⅝ths; but as I have shown that the die is too short, they would be about the same length if made the same distance between the centres. All the advantages, then, that the Hawthorn has, or can have, is ⅝ths of an inch, which he obtains by shortening the die, to the injury, as I consider, of the motion.

I will not enter into "Justitia's" assertion of this link working better an inch shorter than any other. I do not suppose any one would be mad enough to credit this supposition.

To come to my fourth proposition, that the old Stephenson link is the

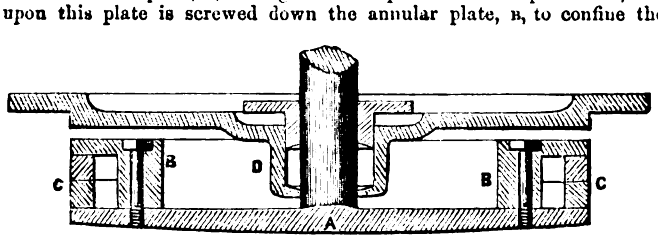
easier reversed of the two, and the better. "Justitia" knows well the use, although he sneers a bit at the idea of counter balance-weights; but, Sir, it is possible to construct the common link motion by their means, such that the weight of the reversing lever itself, inclined a little either way from the centre, will throw it into the backward or forward gear as required. If the Hawthorn eccentric rods are not counterbalanced, it will take something more than this to reverse her, even if standing favourable for it. But, let us see how it can be possible for this engine to be so easily reversed, and we shall suppose two engines with all their rods and links equally balanced. Suppose, also, that their links are standing at the greatest possible angle, and that their valve spindles have the same stroke; but if one is coupled at 9 inches, and the other at 12, one angle must be considerably more acute than the other, and, consequently, worse to reverse, and this is so self-evident, that I will not take up any more of your valuable room in considering it. I may, however, say, I consider the Stephenson link-motion better, in that it is cheaper, easier to keep in repair, has less traps about it, takes up as little room, is easier reversed, and that it has stood the test of experience well, and will do when the Hawthorn motion is forgotten.

J. F., *.

PROPOSED MARINE ENGINE PISTON.

The piston delineated in vertical section in my sketch, will, I think, be useful in engines of an essentially compact construction, as it affords some inches more stroke, by saving the space ordinarily occupied by the top plate and packing.

The bottom plate, A, is forged in one piece with the piston-rod, and upon this plate is screwed down the annular plate, B, to confine the



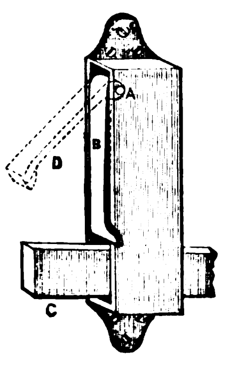
packing rings, C. This allows the cylinder stuffing-box, D, to be sunk below the level of the cover, having free space to work into the upper hollow of the piston. In engines of large size, a small plate may be forged on the piston-rod end, the full sized bottom plate being attached to it by screws.

J. D. Humphreys.

London, January, 1852.

RAILWAY CARRIAGE DOOR FASTENINGS.

A dangerous accident having recently happened on one of the Irish railways, from a gentleman leaning against the door of the carriage, when insecurely fastened, I wish to call your attention to the fastening usually employed in France to close the doors of the diligences. This plan of fastening might be substituted, at a very slight expense, for that at present in use by us; the handle and bolt being the same, the difference being merely in the staple, through which a hole is made, as at A, for the insertion of a pivot, as a joint for the piece of brass, B. When shutting, the bolt, C, pushes the piece, B, into the position shown at D by the dotted lines, but when it has fallen into the horizontal position, the catch falls down as at B. The bolt cannot now rise until B is removed, by pressing against the flange, to bring it to the position of D. I think an improvement might be secured by making one side of the handle heavier than the other so that the bolt would always remain down.



Tau Alpha.

January, 1852.

SUBSTITUTE FOR THE AIR-PUMP IN MINING ENGINES.

Your well-known readiness, at all times, to give your assistance to the mechanic, has induced me to ask your opinion on a point in connection with the use of the air-pump in mining engines. It is evident that a great saving would ensue in the working of the Cornish pumping-engine if we could entirely dispense with the air-pump. Tredgold tells us, its adoption is at the expense of $\frac{1}{10}$th of the engine's power. Now, I propose to produce a better effect than the best air-pump can give, by taking advantage of the adit level occurring in most of the Cornish mines. In very many instances, the water is not brought up to the earth's surface, but is discharged through an adit level some distance down the shaft. I would, in such cases, attach a pipe to the bottom of the condenser, and lead it down the shaft to the adit level—provided, of course, that the adit level is at least 33 feet below the level of the condenser. The column of water would then overcome the atmospheric pressure, and keep the condenser clear.

Novice.

January, 1852.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

J. M. Rendel, Esq., President, in the Chair.

January 13, 1852.

Mr. Rendel, the newly-elected president, opened the first meeting of the year with the usual address, in which, after glancing at the various leading pursuits with which the profession of the engineer is identified, he concluded with the following remarks on the strike of the working engineers:—

"At a period of such regular employment for almost all classes of artizans, and a general absence of complaint, it is unfortunate that any symptoms of dissatisfaction should have been exhibited by a body of men, whose experience, intelligence, and attainments on most subjects, induced the belief that they would be the last to listen to the evil counsels of designing agitators. Disunion between employers and the employed must ever be productive of evil to both; but it invariably ends in permanent injury to the men, whose occupation is the construction of machines, by which manual labour is only apparently superseded, whilst civilization is invariably advanced, by affording mankind increased powers over the materials of the world.

"The result of the present contest between employers, who have invested several millions sterling, in tools, machinery, and buildings; and artizans, who cannot now execute work without the aid of those machines, whose sphere of utility they seek to limit, cannot for an instant be doubtful; and it must be very pernicious influence that could render a body of such intelligent men so unobservant of the true laws regulating supply and demand, as to imagine they could control the prices of the labour necessary to produce those very labour-saving machines of their own manufacture, and which it is evidently their true interest to see multiplied. If their avowed objects were attained, the only result would be such an increased cost of machinery, and such uncertainty in its production, that either the trade would be driven to other countries, or the factories here must be manned by skilled foreign workmen, whose productions are, even now, scarcely second to our own.

"It is to be fervently hoped, that the men will discard the erroneous notion, that 'capital is the foe of labour;' and, as the employers have expressed their willingness to consider any individual representations, made in a fitting manner, this unhappy dispute may be arranged without prejudice to either party."

ROYAL INSTITUTION.

The following constitute the probable Friday evening arrangements for lectures, till Easter:—

Jan. 23. Professor Faraday—"On the Lines of Magnetic Force."
„ 30. Professor Brande—"On Electro-magnetic Clocks."
Feb. 6. Mr. Scott Russell—"On Wave-line Yachts and Ships."
„ 13. Mr. W. R. Grove—"On the Heating effects of Electricity and Magnetism."
„ 20. Mr. F. C. Penrose—"On some Relations of Science to Architecture, considered as a Fine Art."
„ 27. Dr. Lyon Playfair—"On Three Important Chemical Discoveries from the Exhibition of 1851. *a* Mercer's Contraction of Cotton by Alkalies. *b*, Young's Paraffine and Mineral Oil from Coal. *c*, Schrötter's Amorphous Phosphorus."
Mar. 5. Dr. G. A. Mandell—"On the structure of the Iguanodon and other Saurians from the Wealden Formation of the South-east of England."
„ 12. Dr. W. B. Carpenter—"On the Influence of Suggestion in Modifying and Directing Muscular Movement, independently of Volition."
„ 19. T. T. Bigsby, M.D., F.G.S., M.R.I.—(Formerly British Secretary to the Canadian Boundary Commission)—"Illustrations of Lake Superior."
„ 26. Professor Cowper—"On the Principles of the Construction and Security of Locks."
April 2. Sir Charles Lyell—"On the Blackheath Pebble-bed, and on certain Phenomena in the Geology of the Neighbourhood of London."

The Friday evening arrangements depend, in great measure, on the kindness of distinguished men, whose time is subject to the sudden claims of public or professional duty; they are, therefore, liable to change.

SOCIETY OF ARTS.

Dec. 10.

Dr. Faraday in the Chair.

Professor Owen (as one of the twelve gentlemen appointed to deliver lectures upon the classes of objects in the Great Exhibition) proceeded to discourse upon animal products used in the Arts. He successively treated of wool, hair, silk, whalebone, horn, ivory, gelatine, pearls, and cameos; giving some of their histories, and detailing the great labour undergone by the jury, who awarded the various prizes, in coming to just conclusions on the subject. A series of diagrams, showing the microscopic appearances of hair, wool, &c, was exhibited, and very agreeably explained. But as it was signified at the meeting that this lecture would be printed, we refrain from further comment, until we do so in the course we propose to adopt with regard to all these important discourses, as they shall successively be published. It is scarcely necessary to say that the large room was crowded by a delighted auditory.

Wednesday, Dec. 17.

George Moffat, Esq., M.P., in the Chair.

Jacob Bell, Esq., M.P., proceeded to deliver his discourse on "The Chemical and Pharmaceutical Processes and Products in the Great Exhibition." With the exception of some little dallying with the favourite political subjects of the lecturer, and for which, subsequently, he was gently remonstrated with by the chairman, the lecture was so exclusively confined to the particular subject, as to be almost entirely out of our jurisdiction. The comparatively small room of the Society was crowded to excess.

Wednesday, January 7.

Thomas Henry Gibson, Esq., in the Chair.

Dr. Lyon Playfair, F.R.S., proceeded to deliver the fifth lecture of the course of lectures on the results of the Exhibition. The subject chosen was:—"The chemical principles involved in the Manufactures shown at the Exhibition, as a proof of the necessity of an Industrial Education."

The Professor began by briefly referring to the relations between a lower and a higher degree of civilization, and to the prime distinction of the latter in the economy of time, exhibited in all productions of the present day. Human labour and certain principles of beauty, are, obviously, common to both the ancient and the modern world; but that which enables us to form some scale of civilization, is by estimating the greater or the less employment of natural processes. Before the analytical sciences established in the present age, man depended for advancement upon the deductive science of mechanics, which was first applied. After adverting to chemistry as an essentially experimental science, and the last exemplification of the result of man's inquiry into nature, and enlarging upon some of the benefits which it has evolved, the lecturer generalised these benefits into two principal classes, viz., those producing economy of labour, and those producing economy of time; while a third most important advantage resulted in rendering objects which were, in former days, completely useless, in the highest degree valuable.

Dr. Playfair proposed, then, to treat of the first part of his subject as distributed under three heads:—

1. Chemical appliances as adding to human power.
2. Economy of time, resulting from the simplification of productional processes; and,
3. The conversion of the useless and wasted into materials of value.

After mentioning the great social benefits which inevitably result from the economy of labour and time, in which he alluded to the Greek fire—first made use of at the siege of Constantinople—gunpowder, gas, and the electric telegraph, he traced the progress of discovery in the subject before him in a direction of simplification, amusingly illustrating his position by reference to Charles Lamb's celebrated essay. Hoti, the Chinese lad, in the absence of his governor, happened to originate a fire, in which one of the little pigs kept by him was roasted. Hoti, desirous of saving the pig, touched him, and, as a natural consequence, burnt his fingers, which applying to his mouth, he, for the first time in the history of the world, as Elia relates, tasted crackling. His father came home and saw him devouring the unclean thing, but, being induced to taste it, he too forthwith kindled another conflagration, and found "roast pig" not so disagreeable a relish. Fires at his establishment were observed to be, afterwards, very frequent; the neighbours soon discovered their proper significance, and wherever pigs were kept, there houses were set on fire, to enable the occupants to enjoy the dainty morsel. After many ages, the historian goes on to tell us, the unsophisticated inhabitants of the Celestial Empire ascertained by dear-bought experience that the result might be obtained at considerably less cost and damage, until the very ordinary process, which has come down to our own times, was hit upon by some indigenous philosopher, and it was found how simply the object could be attained. Now, this story is not without pertinence, and exemplifies the endeavour made in these later times to render the complex simple. On the third head the lecturer proceeded to show how chemistry economises every scrap of refuse, and makes it available for some useful purpose.

Dr. Playfair then treated, separately, some of the principal articles found in the Great Exhibition of all nations.

First, with regard to *textile fabrics*, he showed the importance of chemistry in the bleaching process; and compared, with immense advantage to that process recently adopted, the old and new methods of accomplishing the object. The great length of time—extending to many months—which it formerly took, have, by the application of sulphuric acid and chlorine successively, reduced the time to a few hours, and even, in many cases, very much less. In demonstrating the benefit of theoretical knowledge, he showed, by statistical detail, the advantage resulting from the introduction of soda in the process of washing articles of domestic use. He next adverted to the superior dyes which are capable, now, of being applied to all textile fabrics, and instanced the case of the exquisite blue colour, called ultramarine, originally and solely produced by an expensive and dilatory process from the mineral called *Lapis lazuli*, and which was once sold at sixty guineas per pound, being now, by the analytical and synthetical labours of the retired student of nature, produced so speedily—and yet identically the same in chemical constituents—as to be of only three or four shillings per pound in commercial value. He then touched upon the subject of mordants, exemplifying how science had tended to the progress of the difficult practical art of fixing the colours given to textile fabrics, by the chemical constituents of cheese and other ordinary substances. It was known that the natives of the east made use of a kind of sealing-wax to cover those spots which, in their silks and linens, when dyed, were required to be left white. This is now performed by means of the application of an acid to what was considered, formerly, as but the refuse of madder, and which was actually thrown away as useless; the parts to which this application is made having the power to resist mordants.

With regard to *leather*, the processes in its manufacture were stated to be less advanced by chemistry than other arts; although the subject is, unquestionably, better understood. He alluded to the process of tanning by means of oak-bark, and the recent use of sumach, producing the effect required in a shorter time. He compared the atmospheric with the hydrostatic process, and referred to the wide chasm alleged to exist between the laboratory and the workshop. It is necessary that the labours in each should be combined to produce the desired benefit. Hair was formerly shaved off with a knife, now the hide is steeped in lime water, and the hair can be easily removed even by the gentle friction of the hand. Morocco leather is produced by the tanning of goat skins, and no less a sum than £5,000 is annually paid to collectors of dog-kennel refuse, as an indispensable ingredient in the production of that beautiful material, fitted for its ultimate purposes. Besides, what was but lately thrown away as waste in leather-manufacture, is now, by chemistry, converted into the pigment known by the name of Prussian blue.

After slightly touching upon *glass and pottery*, as having both been greatly advanced by chemical means, the learned Professor mentioned the important article *soap*, and referred to many points in its history gradually resulting in the process now made use of, rendering it so cheap a commodity as it now is. He alluded to the unwise commercial restrictions upon the import of Russian fats, but which turned attention to the substitutes now used, of palm and cocoa-nut oils, which analysis has found to contain precisely identical elements with those contained in the fat, but lately so largely imported from the north of Europe.

He went on to allude to the artificial means which this analytical science affords of producing many kinds of natural *perfumes*, such as oils of apples, pears, pines, &c., the naming of some of the ingredients of which excited much amusement to the uninitiated.

On the important subject of artificial light by means of candles, he gratefully alluded to the admirable report of Jury 29, and noticed the stages of the manufacture of what are erroneously called stearine candles, and showed the great and profitable decrease in the use of arsenic in the process, by the simple substitution of a small quantity of wax, rendering the article of sufficient consistency, which was the object in making use of the poison.

ROYAL SCOTTISH SOCIETY OF ARTS.

January 12, 1852.

"On some new methods calculated to facilitate the application of Ancient Arts to the Decoration of Sepulchral Monuments," by Dr. Wilson.

"On the Platometer,"* by Mr. John Sang, of Kirkcaldy.

"On a Galvanic Apparatus for Medical purposes," by Mr. W. Hart, of Jedburgh.

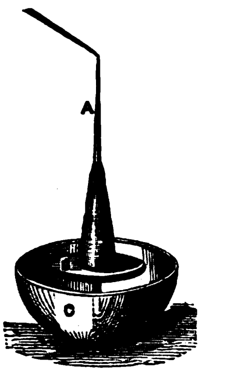
MONTHLY NOTES.

Mine Accidents.—The isolated statements of the daily press afford the general reader but a loose idea of the actual fearful loss of life constantly occurring in our coal-pits. The annual returns, however, place the matter in a very different light. From them we find that, in 1850, the deaths from all causes reached the alarming number of 632, the injuries, 273—making a total of casualties of 905. Half-year to June 30th, 1851:—Deaths from all causes, 310; injuries, 110—420. Half-year to December 31, 1851:—Deaths from explosions, 160; deaths from fall of roof, 72; deaths from fall in shaft, 30; deaths from rope breaking, 38; various causes, 72; injuries from all causes, 136—508. For the year:—Deaths from all causes, 682; injuries, 246—928; being 57 per month killed and 23 injured. This is a most lamentable list, when we reflect how many of these lives might have been saved, by closer attention to modern improvements in ventilation, and the more general adoption of safety cages.

Clarkson's Cork, Canvas, and Wood Life-Boat.—A life-boat, built of alternate layers of sheet-cork, canvas, and wood, 21 feet long, 6 feet 6 inches beam,

* See *ante*, page 196, for engraving and description of this instrument.

and weighing 11 cwt., has been recently submitted to Government test, by its inventor, Mr Clarkson, of Paris. The authorities here report it to be well suited for small steamers, as it possesses great buoyancy, and is easily rowed. When filled with water, and having a ton of ballast on board, and one person standing on the gunwale, it could not be upset. Portions of the material, joined with marine glue, have also been tested by pressure and percussion. When placed under the steam-hammer, the first blow with a fall of a foot caused it to yield about one-third of its thickness, whilst it afterwards returned to its original dimensions. Deal and oak were broken to splinters under similar treatment.



Central American Indian Spindle.—In Nicaragua, the antiquated foot-wheel is still extensively used for spinning cotton, and even the essentially primitive contrivance employed previous to the Conquest is not yet quite out of date. The annexed sketch exhibits this interesting curiosity as a strangely remarkable contrast to our complete and wonder-working mechanism. A spindle, A, of hard wood, 16 or 18 inches long, has fast upon it a heavy disc of wood, B, near its lower end, serving as a fly to give it momentum. The foot of the spindle is rudely pointed, and, when in use, it is placed in a calabash, C. The spinster seats herself on a stool, and, taking a supply of loose cotton in her lap, she twists a thread with her fingers, attaching the end to the top of the spindle, giving the latter a good twirl to keep up its revolution for some time. Whilst the spindle revolves, she disengages and draws out the cotton from her lap with both hands, and the length of thread thus spun—usually two or three feet—is then wound upon the spindle, another length being added, until the spindle is full.

Safety of Iron Ships from Fire.—We have just been read a fearful lesson in the fate of the luckless "Amazon." Shall we ever take a hint for improvement, without burning bishops in railway carriages, or precipitating hundreds of human beings to the most fearful of all deaths, as we have just done in the "Amazon?" It is now a year or two since the "Viceroy," Glasgow and Dublin iron steamer, ran into Loch Ryan with her cabins totally burnt out. The ship was no worse, as far as her iron hull went, and no passengers were lost. Had she been wood, the probability is, that the distressing fate of the "Amazon" would have been thus early anticipated. It is to be hoped that the severe caution which the Royal Mail Company has just received will have its due weight, as well in operating for the general use of iron in our mercantile marine as in removing the foolish Admiralty ban upon this material with regard to its failure under the effect of shot. Had we not better, at any rate, be shot than burnt?

The "Acolyte" Safety Candle-Cap.—This little instrument is intended for the increase of the effective light of ordinary candles, the diminution of their rate of consumption, and the prevention of the waste and disagreeable results of "guttering," or overflowing of the melted tallow at the point of combustion. Fig. 1 is an external view of the "acolyte," as fitted to the top of a lighted candle; and fig. 2 is a corresponding vertical section. It consists in the combination of a cap of metal, as a heat-conducting substance, regulating the supply to the wick, with a guide of glass as a non-conductor, maintaining its perpendicularity without communicating heat to melt the lower portion of the candle. In common kinds, a lining of plaster of Paris is employed as the non-conducting medium. The instrument, when placed on a lighted candle, gradually descends by its own weight as the tallow burns away, and may be used with the last remnant of the candle by the aid of a suitable save-all. The acolyte is also available for carrying a shade.

Fig. 1.

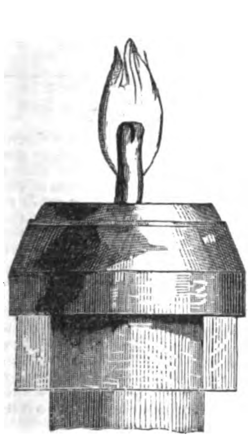
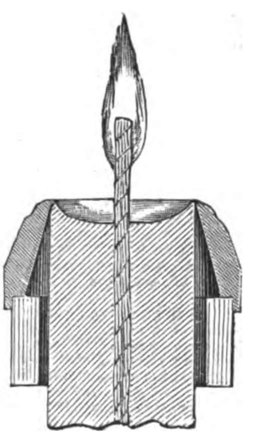


Fig. 2.



The Artificial Irrigation of Madeira.—The shifts to which the people in very dry countries are driven to procure a scant supply of water, are vividly described in the following extract from the letter of a correspondent resident in Funchal, the chief town of Madeira:—"If artificial irrigation were not in use, the island, for more than half the year, would be little more than a bare rock. Months sometimes pass without a drop of rain, and even during the winter, when a good deal of rain falls at intervals, water is frequently wanted by the vines, yams, and other plants. This water is supplied by artificial channels, called Levadas, which bring it down from the springs on the mountains to every vineyard, and to every garden, by very circuitous courses. The water is not always running into any one plot of ground; every plot takes its turn in a cycle or "giro" of a fortnight, to have so many hours' run of water as the owner may have purchased from the Levada conservators at the beginning of the year. For instance, I have the right of an hour and a-half's flow of water every fortnight into the garden adjoining my house. Sometimes it comes in the day-time, at others in the night, according to notice sent beforehand. It is rather an amusing thing to witness the anxiety of the labourers when waiting for the water, and their excitement when it rushes, at length, through the hole in the wall into the fazenda. Channels have been previously made throughout the garden, so that every foot of planted ground may receive its share. Then you see the fellows armed with hoes, hurrying about here and there, clearing away obstructions, deepening at one place, damming up at another, all the time bawling out at the top of their voices, in Madeira patois. If the proceeding takes place at night, then there is the picturesque addition of torches."

ENGLISH PATENTS.

Sealed from 15th December, 1851, to 13th January, 1852.

Thomas Twells, Nottingham, manufacturer,—"Certain improvements in the manufacture of looped fabrics."—December 15th.

Frederick William Norton, Paisley, Renfrewshire, North Britain, manufacturer,—"Certain improvements in the manufacture or production of plain and figured fabrics."—16th.

John Gedge, 4 Wellington-street, Strand, Middlesex,—"Improvements in the treatment of certain substances for the production of manures."—(Being a communication.)—16th.

James Souter and James Worton, Birmingham,—"Improvements in the manufacture of papier-mache and in articles made therefrom, and in the manufacture of buttons, studs, and other articles where metal and glass are combined."—17th.

William Hirst, Manchester, manufacturer,—"Certain improvements in machinery, or apparatus for manufacturing woollen cloth, and cloth made from wool and other materials."—19th.

Moses Poole, gentleman,—"Improvements in apparatus for excluding dust and other matters from railway carriages, and for ventilating them."—(Being a communication.)—19th.

Henry Clayton, Atlas Works, Upper Park-place, Dorset-square,—"Improvements in the manufacture of tubes, pipes, tiles, and other articles, made from plastic materials."—19th.

Samuel Wilkes, Wolverhampton, brass-founder,—"Improvents in the manufacture of kettles, saucepans, and other cooking vessels."—19th.

Joseph Burch, Craig Works, Macclesfield,—"Improvements in printing and manufacturing cut pile and other fabrics and yarns."—19th.

Christopher Rands, Shad Thames, miller,—"Improvements in grinding wheat and other grain." 19th.

James Frederick Lackerstein, Kensington-square, civil engineer,—"Improvements in machinery for cutting or splitting wood and other substances, and in the manufacture of boxes."—19th.

Frederick Bousfield, Devonshire-place, Islington, gentleman,—"A new manufacture of manure."—19th.

Charles Howland, New York, engineer,—"Improvements in apparatus for ascertaining and indicating the supply of water in steam-boilers."—19th.

William Elliott, Birmingham, manufacturer,—"Improvements in the manufacture of covered buttons."—19th.

Rodolphe Helbronner, Regent-street,—"Improvements in apparatus used when obtaining instantaneous light."—19th.

John Thornton and James Thornton, Melbourne, Derby, mechanics,—"Improvements in the manufacture of meshed and looped fabrics, and other weavings, and in raising pile and looped fabrics and other weavings."—19th.

William Emery Milligan, mechanical engineer, New York,—"Certain improvements in the construction of boilers for generating steam."—19th.

Charles Lamport, Workington, Cumberland, ship-builder,—"Improvements in reefing sails."—19th.

Richard Archibald Brooman, of the firm of J. C. Robertson & Co., Fleet-street, patent-agents,—"Improvements in sounding instruments."—(Being a communication.)—19th.

John Davie Morries Stirling, Black-grange, North Britain, Esq.,—"Certain alloys and combinations of metals."—22d.

Sydney Smith, Nottingham,—"Improvements in indicating the height of water in steam-boilers."—22d.

Augustus Applegarth, Dartford, Kent,—"Improvements in machinery used for printing."—24th.

Antonia de Sola, Madrid, Spain,—"Certain improvements in the treatment of copper minerals."—(Being a communication.)—24th.

Christopher Nickels, York-road, Lambeth, and Thomas Ball and John Woodhouse Bagley, Nottingham,—"Improvements in the manufacture of knitted, looped, and other elastic fabrics."—24th.

Alfred Vincent Newton, Chancery-lane, Middlesex, mechanical draughtsman,—"Improvements in separating substances of different specific gravities."—24th.

Joseph Stenson, Northampton, engineer and iron manufacturer,—"Improvements in the manufacture of iron, and in the steam apparatus used therein, part or parts of which are also applicable to evaporative and motive purposes generally."—27th.

Robert Beck Froggatt, Sale Moor, Chester, manufacturing analytical chemist,—"Improvements in the preparation of certain compounds to be used for the purpose of rendering woven and textile fabrics, paper, leather, wood, or other materials or substances waterproof and fire-proof, and also in machinery or apparatus employed therein."—31st.

Francis Hastings Greenstreet, Albany-street, Mornington-crescent,—"Improvements in coating and ornamenting zinc."—31st.

George Gwynne, Hyde Park-square, Middlesex, Esq., and George Fergusson Wilson, managing director of Price's Patent Candle Manufactory, Belmont, Vauxhall,—"Improvements in treating fatty and oily matters, and in the manufacture of lamps, candles, night-lamps, and soap."—31st.

George Collier, Halifax, Yorkshire, mechanic,—"Improvements in the manufacture of carpets and other fabrics."—31st.

Francis Clark Monatis, Earlstown, Berwick, builder,—"Improved hydraulic syphon."—31st.

David Napier, Millwall, engineer,—"Improvements in steam-engines."—31st.

Thomas Barnett, Kingston-upon-Hull, grocer,—"Improvements in machinery for grinding wheat and other grain."—January 8.

Joseph Addenbrooke, Bartlett's-passage, London, envelope manufacturer,—"Improvements in the manufacture of envelopes, and in machinery used therein."—8th.

Charles Dickson Archibald, Portland-place, Middlesex, Esq.,—"Improvements in the manufacture of bricks and other articles made of plastic materials, and in cutting, shaping, and dressing the same, as also stone, wood, and metals, and in machinery and apparatus employed therein."—(Communication.)—8th.

William Cook, Kingston-upon-Hull, working copper-smith,—"Certain improvements in the construction of steam-engines, consisting of a rotatory circular valve for the regular admission of steam from the boiler alternately into the chambers of the two cylinders of double-acting engines."—12th.

Alcide Marcellin Duthoit, Paris, France, statuary,—"An improved chemical combination of certain agents for obtaining a new plastic product."—12th.

Robert John Smith, Islington, Middlesex, gentleman,—"Certain improvements in machinery or apparatus for steering ships and other vessels."—12th.

Jean Antoine Farina, Paris, proprietor,—"A process for manufacturing paper."—13th.

SCOTCH PATENTS.

Sealed from 22d November, 1851, to 22d January, 1852.

Richard Whytock, Edinburgh,—"Improvements in applying colours to yarns or threads, and in weaving or producing fabrics when coloured or party-coloured yarns or threads are employed."—November 24th.

Thomas Crook, Preston, Lancaster, cotton manufacturer, and James Mason, of Preston aforesaid, warper,—"Certain improvements in looms for weaving."—26th.

Thomas Cussons, Bunhill-row, Middlesex,—"Improvements in ornamenting woven fabrics for bookbinding and its uses."—26th.

Henry Ellwood, of the firm of Ellwood & Sons, Great Charlotte-street, Blackfriars-road, Surrey, wholesale hat manufacturers,—"Improvements in the manufactnre of hats and other coverings for the head."—26th.

John Ashworth, Bristol, manager of the Great Western Cotton Works,—"Certain improvements in the method of preventing and removing incrustation in steam boilers and steam generators."—26th.

Joshua Grindrod, Birkenhead, Chester, consulting engineer,—"An improvement in the machinery for communicating motion from steam-engines, or other motive power, and in the construction of rudders for vessels."—December 1st.

William Bridges Adams, No. 1 Adam-street, Adelphi, Middlesex, engineer,—"Certain improvements in the construction of roads and ways for the transit of passengers, of materials, and of goods; also, in building and in bridges, parts of which improvements are applicable to other like purposes."—4th.

Godfrey Ermen, Manchester, Lancaster, cotton-spinner,—"Certain improvements in the method of, and apparatus for, finishing yarns or threads."—8th.

James Nasmyth, Patricroft, Lancaster, engineer, and Herbert Minton, Stoke-upon-Trent, Stafford, china manufacturer,—"Certain improvements in machinery or apparatus to be employed in the manufacture of tiles, bricks, and other articles, from disintegrated or pulverized clay."—11th.

Frederick William Norton, Paisley, Renfrew, North Britain, manufacturer,—"Certain improvements in the manufacture or production of plain and figured fabrics."—12th.

John Cumming, Paisley, Renfrew, North Britain, pattern designer,—"Improvements in the production of surfaces for printing or ornamenting fabrics."—15th.

John Livesey, New Lenton, Nottingham, draughtsman,—"Improvements in the manufacture of textile fabrics, and in machinery for producing the same."—15th.

Augustus Applegarth, Dartford, Kent,—"Improvements in machinery used for printing."—22d.

William Dickinson, Blackburn, Lancaster, machine maker,—"Certain improvements in machinery or apparatus for manufacturing textile fabrics."—22d.

George Gwynne, Hyde Park Square, Middlesex, Esq., and George Fergusson Wilson, managing director of Price's Patent Candle Company, Belmont, Vauxhall,—"Improvements in treating fatty and oily matters, and in the manufacture of lamps, candles, night lights, and soap."—22d.

Herman Schroeder, Bristol, gentleman,—"Improvements in the manufacture and refining of sugar, which improvements are applicable to evaporating other fluids where a low temperature is advantageous."—22d.

James Macnee, Glasgow, Lanarkshire, North Britain, merchant,—"Improvements in the manufacture or production of ornamental fabrics."—26th.

Jeane Antoine Farina, Paris, France, proprietor,—"A process for manufacturing paper from a certain material."—26th.

Francis Hastings Greenstreet, Albany-street, Mornington-crescent, Middlesex,—"Improvements in coating and ornamenting zinc."—29th.

Frederick Rosenborg, Albany, Middlesex, Esq.,—"Improvements in the manufacture of casks, barrels, and other like articles, and the machinery employed therein.—January 2d, 1852.

James Aikman, Paisley, Renfrewshire, North Britain, calenderer,—"Improvements in the treatment or finishing of textile fabrics and materials."—6th.

James Gathercole, Eltham, Kent, envelope manufacturer,—"Improvements in the manufacture and ornamenting of envelopes, parts of which improvements are applicable to other descriptions of stationary, and in the machinery, apparatus, and means to be used therein."—8th.

Edwin Rose, Manchester, Lancashire, engineer,—"Certain improvements in boilers for generating steam."—9th.

Thomas Richardson, Newcastle-upon-Tyne,—"Improvements in the manufacture and preparation of magnesia, and some of its salts."—12th.

James Warren, Montague-terrace, Mile-end-road, gentleman,—"Improvements applicable to railways and railway carriages, and improvements in paving."—13th.

Alexander Parkes, Birmingham,—"Improvements in separating silver from other metals."—13th.

Alexander Hediard, 26 Rue Taitbout, Paris, France,—"Improvements in propelling and navigating ships, boats, and vessels by steam, and other motive power."—16th.

IRISH PATENTS.

Sealed from 20th November, 1851, to 19th January, 1852.

Thomas Crook, Preston, Lancaster, cotton manufacturer, and James Mason, of Preston aforesaid, warper,—"Certain improvements in looms for weaving."—November 20th.

Henry Richardson, Aber Hernant, Bala, North Wales, Esq.,—"Certain improvements in life boats."—20th.

George Tate, Bawtry, York, gentleman,—"Improvements in the construction of dwelling houses and other buildings, including carriages and floating vessels, and in the propulsion of said vessels, and the adaptation and manufacture of materials for such uses."—December 2d.

Philip Nind, Leicester-square, gentleman,—"Improvements in the manufacture of sugar, in distilling and in cutting and rasping vegetable substances."—2d.

George Fergusson Wilson, managing director of Price's Patent Candle Company, Vauxhall; David Wilson, Handsworth, Esq.; James Childs, Putney, Esq.; and John Jackson, Vauxhall, gentleman, all in the county of Surrey,—"Improvements in presses and matting, and in the process of and apparatus for treating fatty and oily matters, and in the manufacturing of candles and night lights."—19th.

Alphonse René Le Mire, de Normandy, Judd Street, Middlesex, gentleman, and Richard Fell, City Road, Middlesex, engineer,—"Improved methods of obtaining fresh water from salt water, and of concentrating sulphuric acid."—22d.

Charles Watt, Kennington, Surrey, chemist,—"Improvements in the decomposition of saline and other substances, and separating their component parts, or some of them, from each other; also, in the forming certain compounds or combinations of substances, and also in the separating of metals from each other, and in freeing them from impurities."—22d.

Matthew Gibson, Wellington-terrace, Newcastle-upon-Tyne,—Improvements in machinery for pulverising and preparing land."—January 3d, 1852.

De Antoine Dominique Sisco, Slough,—"Improvements in the manufacture of chairs and in combining iron with other metal applicable to such, and other manufacture."—3d

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 12th December, 1851, to 14th January, 1852.

Dec. 12th,	3057.	Edward John Dent, Strand,—"Prismatic balance."
13th,	3058.	James Neighbour, High-street, Windsor,—"Geometrical fimbria, or shirt, with graduating corset."
16th,	3059.	Charles Rowley, Birmingham,—"Lead and slate pencils, and crayon sharpener."
—	3060.	Williamson & Roberts, Heaton Norris, Lancaster,—"Apparatus for taking up the cloth in looms."
—	3061.	Edward Kesterton, Long-acre,—"Frame for carriage-windows."
17th,	3062.	Joseph Welch and John Margetson, Cheapside,—"Oxonian shirt-front."
—	3063.	Samuel Whitfield, Birmingham,—"Fastening for metallic bed-steads."
18th,	3064.	James Haywood, Derby,—"Stench-trap."
20th,	3065.	Charles Lenny, Croydon,—"Wicker-bodied carriage."
23d,	3066.	J. J. Lane, Bethnal-green,—"Lozenge-cutting machine."
26th,	3067.	James Black, Edinburgh,—"Paper-cutting machine."
27th,	3068.	F. T. Jones & Co., London,—"Moulding to be used as a picture-rod."
—	3069.	W. Pech, Sheffield,—"Non-equal shears."
29th,	3070.	J. Chesterman, Sheffield,—"Double expanding and contracting spanner."
30th,	3071.	Henry Kearsley, Ripon, Yorkshire,—"General tile-screening or grinding and brick-machine."
Jan. 1st, 1852,	3072.	George N. Haden, Trowbridge,—"Hand hard-labour machine."
—	3073.	J. Thornton & Sons, Birmingham,—"Railway-carriage roof-lamp."
2d,	3074.	John Ferrabée, Stroud,—"Grass-cutter."
—	3075.	John Hughes, Lee, Kent,—"Nursery yacht."
—	3076.	Victor Angiers, Fitzroy-square,—"Design for brushes."
10th,	3077.	Walsh & Brierley, Halifax,—"Double bar brace-slide."
12th,	3078.	J. & T. Brown, Bradford,—"Pressing lever."
—	3079.	T. Johnson, Manchester,—"Compound spring for a printing-press."
—	3080.	G. Lewis, Leicester,—"Lock."
13th,	3081.	W. Pearse, Tavistock,—"Roasting-jack."
—	3082.	R. Gordon, and J. Thomson, Stockport and Manchester,—"Hollow wrought-iron yarn-beam, back-roller, and cloth-beam."
14th,	3083.	S. Samuel, Houndsditch,—"Cap-peak."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 16th December, 1851, to 15th January, 1852.

Dec. 16th,	340.	Cyrus & J. Clark, Street, Somerset,—"Elastic gusset for boots."
17th,	341.	George Pate Cooper, Suffolk-street, Pall-mall,—"Elliptic gusset."
19th,	342.	Felix P. Rovére, New-inn, Strand,—"Safety-catch for window-sashes."
23d,	343.	Frederick Bristley, Fitzroy-square,—"Fastening."
—	344.	Moritz Pillischer, Oxford-street,—"Elliptical compasses."
24th,	345.	Francis Higginson, Lieut., R.N., Pentonville,—"Apparatus for laying down submarine electric telegraphic cables, and electric wires, along railways."
Jan. 2d,	346.	Thomas Good, Church-street, Soho,—"Somatometer, or self-acting indicator of the figure."
15th,	347.	H. de Beaufort, Great Ryder-street,—"Measuring indicator."

TO READERS AND CORRESPONDENTS.

A BEGINNER.—It was no part of our business to know that his former inquiry referred to a still younger "beginner." Our reply, as a matter of course, was based upon the written note. No one who has a right to boast of "proficiency" would have put such a question. What are "oscillating engines of simple mechanism?" Small engines of the oscillating class are frequently made without slide-valves, the oscillation being made to bring the steam and exhaust ports, formed in the trunions, to the proper positions at the right times. Such contrivances are, however, very crude, and all large engines have slide-valves actuated by eccentrics in the usual way—see our plates 70 and 71, of the "Victoria," in May last. The engine which he mentions has been often described. He will find several examples of oscillators in the back parts of the *Practical Mechanic's Journal*.

ADMIRER.—The compound pump acts as we have described, just as Ruthven's combined fans give a higher pressure of furnace-blast. Each disc, of course, adds its own individual effect, as the fluid passes from one to the other. He confounds the terms *pressure* and *motion*. The annular air vessels give a certain pressure to the water as it is discharged from the first disc, and the second disc then acts upon the water, as acted on by this elevating pressure, and the pressure increases—not the motion—until the water leaves the last disc under the accumulated air pressure of the entire series. The invention is being rapidly introduced.

We have already condemned the system of hand-brakes for mine-cages. His plan seems to be little else than a modification of Messrs. White & Grant's successful apparatus. There are various contrivances for weighing and registering machines. Perhaps some of our correspondents may be able to point out good examples of the kind.

T. W.—We will attend to his note as early as we can find suitable matter.

W. J. H.—Received, and will be noticed next month.

Received.—"Metropolitan Streets and Suburban Omnibus Railway and Parcels Delivery Company." "United Kingdom Land Investment and Improvement Society."

A. G., Hamburgh.—We have forwarded a descriptive pamphlet to his address, by post.

J. A. W., Genoa.—We shall write him fully so soon as we have all the information which he requires.

W.—We are obliged for his suggestion. The process, however, was not by any means overlooked. A paper upon it was intended for the present part, but cannot now be given until next month.

Received.—"Representation of the Case of the Executive Committee of the Central Association of Employers of Operative Engineers." "Notes on the Organization of an Industrial College for Artizans," by T. Twining, jun.—"The Dictionary of Domestic Medicine and Household Surgery." By Spencer Thompson, M.D., L.R.C.S., Edinburgh. Part I., London, Groombridge and Sons.—"Text Book of Geometrical Drawing." By W. Minifie, Architect, Baltimore, U.S. Third Edition, 1851.

W. D. S.—Next month.

DISCOVERY AND INVENTION.

V.

The instances lately given of what we have ventured to term *co-ordinate discovery and invention*, were derived solely from the practical arts and sciences. But there is a very much wider field from which analogous examples may be profitably culled. This wider field is literature. We do not remember to have seen this matter any where even proposed. Many authors have entered into the question of the connection between science and literature, but what they have said has rather been to prove the advantages which science derives from literature, as her amanuensis, in preserving, for the use of distant ages and remote nations, those generalizations with which science deals, and which might otherwise be lost when dependent for continued existence upon oral tradition. It seems to have been overlooked, that *literature itself forms an immense magazine of facts*, requiring only observation, arrangement, and generalization, to make it ancillary to scientific ends of such high relative importance, as the facts it presents are to facts as observed by the simple exercise of the senses. In literature, not only by further generalizing generalizations, may the laws of physical phenomena be eliminated, but the laws of the operation of man's mind. This has, indeed, in some measure, been rudely recognised in what is called *style* of composition; but it is obvious, that all the little infinite points which are congregated together to make up that style, are entitled to far greater consideration. Style is as the surface of a country which we may know to be mountainous or plain, abounding or not with rivers and cataracts, with woods or pleasant fields—the matter forming the style being as the great geological world beneath; or we would compare it rather to the mere outward form of man, while that which is *within it* are the intricate concatenations of structure and function which really make up the sum of being, particular and general.

It is out of our province to enter into this wide subject, except so far as it is connected with that before us. As regards discovery and invention, we think there are some facts lying exposed upon the very surface of literature, which may afford some instances of that more intimate connection between it and science above suggested, as well as assist us in our present investigation.

Whole volumes, and papers and articles innumerable, have been written on the subject of literary plagiarism. We would view this subject somewhat antithetically. These assumed plagiarisms have, probably, attracted notice from the very extent of the domain in which they have been supposed to be found. Instances of scientific plagiary which have been attempted to be exposed are rare, in comparison with those alleged to be proved in printed pages. It is natural that this should be the case where the many write, and the few only scientifically observe.

Before, however, giving instances of discovery or invention in the collocation of words or ideas, it may not be improper to show that in this, as in other matters, there exists a state of transition, in which physical action is derived from written precept, examples of which the reader can readily take from his own personal experience. Doubtless we discover and invent, and act upon our discovery and invention, in many of the most important scenes of life. When this is exclusively the case, we are really acting upon scientific principles, although we may not have the remotest idea that we are doing so; for each individual, by his very nature, has the elements of scientific *procedure* within him. He may, indeed, almost be said to be fettered by them. But how often still can we not trace any action performed or meditated to the principle, or to the precept, which both become to us as facts which we are bound to observe, and which we have proved, or are about to prove, we have carefully observed? What is this, indeed, but the very root and foundation of all education, as well as its result? Nothing more need be said upon this at present.

The simplest instances immediately before us are those in which expressions made use of by different authors in different ages are literally, or nearly literally, the same. These have been the most numerously noted down, but, in all probability, only because they are more readily discovered. Of such is that famous sentence attributed to the keenest politician of modern times—the subtle manœuvrer, Talleyrand: "The true end of speech is not so much to express our thoughts, as to conceal them." Why, may not the most gentle spirit have observed and noted down this capability of words in some portion of literature which came across him? Oliver Goldsmith has it in one of his papers in his weekly pamphlet, "The Bee." ——"In dimple sleek," is Milton's; we find the same expression in Dr. Francis' thirteenth ode of Horace—a mere obvious imitation, a true plagiarism. Even bluff old Johnson trips in this way; if you want chapter and verse for his "Drink to me only with thine eyes," you may find it in Burton's "Anatomy of Melancholy," part 2, section 2, mem. 4, sub. 1. Pope finely and truly said, "The proper study of mankind is man." Now, whether Jean Jacques had met with this or not, he said the same thing in almost as few words: "Notre veritable etude est celle de la condition humaine;" and we feel that he might have said it, because it was in his way—in his *style* of thought. In Goldsmith's "Haunch of Venison," we read—

> "Such dainties to them their health it might hurt,
> It's like sending them ruffles when wanting a shirt."

Now Goldsmith had probably read the same thing in the works of "the facetious Thomas Brown:"—"To treat a poor wretch with a bottle of Burgundy, or fill his snuff-box, is like giving a pair of lace-ruffles to a man that has never a shirt on his back." As a further instance of this kind of thing, compare the following passage in Hood's celebrated "Song of the Shirt:"—

> "O brothers, with sisters dear,
> O fathers, with mothers and wives,
> It is not linen you're wearing out,
> But human people's lives!"

with the old Scotch song—

> "Wha'll buy caller herring?
> They're no brought here without brave daring.
> Buy my caller herring;
> Ye little ken their worth.
> Wha'll buy my caller herring?
> O ye may ca' them vulgar faring;
> Wives and mithers, maist despairing,
> Ca' them lives o' men!"

Pope's still more celebrated distich—

> "For modes of faith let senseless bigots fight;
> His can't be wrong whose life is in the right,"

we cannot but refer to two lines in one of Cowley's minor pieces, which were, probably, the parents of Pope's thought—

> "His faith, perhaps, in some nice tenets, might
> Be wrong; his life, I'm sure, was in the right."

There is just a bare possibility, but no probability, that Horace may have read, in the Wisdom of Solomon, "For, say they, we must be getting every way, though it be by evil means;" and yet he has the same thought, "Rem, si possis, recte; si non, quocunque modo, rem." Thomson apostrophizes the sun, "Parent of the seasons;" Byron makes Manfred do the same thing with additional power, "Sire of the seasons!" But Byron is really, in other places, a wholesale plagiarist: many lines together, in his description of the shipwreck in Don Juan, being taken, word for word, from a collection called "Shipwrecks and Disasters at Sea." A very remarkable simile of Moore, in the Epicurean, "Like light that had died," is certainly due to Cumberland in his Calvary—

> "Now a troop
> Of shrouded ghosts, upon a signal given
> By their terrific monarch, start to sight,
> Each with a torch funereal in his grasp,
> That o'er the hall diffused a dying light
> Than darkness 'self more horrible."

The idea is intensified in Moore: here light is dying, there it is dead. The line—

"Like angels' visits, few and far between,"

which is come to be a household phrase, coupled with the ordinary "as Campbell says," really belongs to Blair, who, in his "Grave," writes—

"Like angels' visits, short and far between."

In this instance, we observe that the more recent poet has altered the word "short" into the word "few;" which, although it may add to euphony, makes almost nonsense of the line; for if the visits be far between, they must be few.

But phrases, thoughts, may be considered as simple words when they indicate one idea; and many authors appear to have been as unscrupulous in adopting the thought of others without acknowledgment, or by some means or another to have stumbled or come upon the same. The cases of this description are, in all probability, the most numerous of all, although it may be more difficult and laborious to point them out. Where, however, peculiar forms of expression are made use of, the probability is diminished that the person last in time using them should have invented them. When Robertson tells of "a person who had attained much nearer to pure virtue," or of "a government attaining nearer to perfection," we might give him credit for originality, rather than compel ourselves to believe that he had borrowed his phraseology from the Koran, in which many expressions like this occur. We know that in other matters—music, for instance, in which it is alleged that Handel's "Egypt was glad," is taken from Kerl, note for note—the power of euphony may become so intimately associated with us, as to make us involuntarily catch at something that is pleasing to our own ear, or more subtly sensitive to the mind. This may account for many instances we find of plagiary or co-ordinate invention of peculiar similes, metaphors, and idiomatic terms. The famous simile of the ant in Proverbs, is found *in extenso* in the first satire of Horace: an additional singularity, for it is as difficult to consider the Latin poet conversant with natural history, as it is to suppose that he really had read the Old Testament, or any part of it. Again, Thomson, in his Autumn, describing night amusements, says—

"Confused above,
Glasses and bottles, pipes and gazetteers,
As if the table e'en itself was drunk,
Lie a wet, broken scene."

Charles Lamb, in his Essay on Hogarth, tells us that a friend described the print of Beer Street, "as if the very houses were drunk." It is readily seen how naturally, in this case, the same thought may have supervened upon the view of an analogous collocation of facts. On this point, Sterne, in *his* Koran, has a remark, which we give in his words:—

"In Plato's Phædon, Socrates says that while the soul is immersed in matter, 'it staggers, strays, frets, and is giddy like a man in drink.' There is a passage in the Psalms, from whence one must be almost certain he must have borrowed this image—'They reel to and fro, and stagger like a drunken man, and are at their wits' end.' Here not only the simile is the same, and the expression almost so,—as near as different translations of the same text, not performed by the Septuagint, can be supposed to approach,—but the very occasions are parallel also. The first describes the state of the soul under the power of corporeal affections, and the latter speaks of man unassisted by grace."

Sometimes it may be found, and research in this matter would many times find some one peculiar simile or metaphor repeated over and over again—the same attractive thought occurring under similar circumstances of mental status. George Herbert sweetly sings about the Bible:—

"Oh, that I knew how all thy lights combine,
And the configurations of their glory!
Seeing not only how each verse doth shine,
But all the constellations of the story.
* * * * * * *
Stars are poor books, and oftentimes do miss:
This book of stars lights to eternal bliss."

Who cannot trace in the splendid line of Byron,—

"Ye stars, which are the poetry of heaven,'—

the thought which must have passed through Herbert's mind, although unexpressed, as it was concentrating itself upon the "book of stars," which had kindled his imagination? One year before Byron's line was published, a friend of our own had written and given to the world a sonnet in which the thought was expressed in language almost identical with that of the illustrious and eccentric peer. Old Robert Burton also discourses thus: "The heaven is a great book, whose letters are the stars (as one calls it), wherein are written many strange things for such as can read." It is questionable, however, if any of these come up in beauty to the very same idea of the Psalmist—"There is neither speech nor language, but their voices are heard among them." If fine language be, as Addison says it is, "the expression of sentiments which are natural without being obvious," the palm of first and noblest thought must be given to the sweet singer of Israel. Whether De Quincy had seen Retzsch's Outlines to Schiller's Song of the Bell may not be known; but in telling us, in his Confessions of an English Opium Eater, that when he lay awake in bed, vast processions passed along in mournful pomp—"*friezes of never-ending stories,*"—we know he simply described a portion of one of the beautiful creations of the artist's graver. It may be that the picture may have been borrowed from the written thought, or the written thought from the picture, or neither; and this it is which we believe to have been the fact. Thought in both was independent, and this instance illustrates that law of thought to which we would ascribe all discovery and invention. The famous personification of Sin by Milton may have been suggested by a description in the Theogony of Hesiod; and, knowing our great epic poet's classical learning and taste, we are less assured that the fame reflected upon him by this passage is justly due.

We find this co-ordinate invention even in the details of a long story. In the Preliminary Discourse of Sale to his translation of the Koran, we find a tale combining all the circumstances, so delightfully read of in our youth, of the friendship of Damon and Pythias; the names and the scene of action alone being changed. Now, at first glance, this might appear to afford the strongest evidence of plagiarism; but if we reflect upon the moral, we shall find that, in the absence of certain evidence to the contrary, there is far greater reason to believe that the circumstances actually took place as they are narrated, or were really invented, being precisely those under which the moral was, or could be, best shown.

Not only does this remark apply to a simple story, but to the form of an entire composition. Without insisting on such instances as Horne Tooke's "Diversions of Purley," having been suggested by the broad, general principle attempted to be maintained in Locke's great work "On Human Understanding," we would refer to such instances as the celebrated "Rejected Addresses," for which Ferdinand Galiani had, long before, sketched an outline in a Collection of various pieces on the death of the Executioner at Naples, and which he ascribed, in ridicule, to each of the members of the Academy in that city.

Even the machinery of a piece of writing or poem has exemplified itself, as an instance of the rule which we believe to exist. The quaint "Anatomist" of Melancholy, quoting from some one of his odd authors, says, "The hairs are Cupid's nets, to catch all comers; a brushie wood in which Cupid builds his nest, and under whose shadow all Loves, a thousand several ways, sport themselves." Did Pope adopt the machinery in his "Rape of the Lock" from this? It is, obviously, identical. But was not the idea a natural one? We think it was, and that, had it been kept within due bounds by the poet, it would have appeared more so.

Identity of thought is, as we have already remarked, more difficult to demonstrate, although probably more frequent in literature. How like, in this respect, are the two following—the first by S. T. Coleridge, the second by Shelley:—

"Few sorrows hath she of her own,
My hope! my joy! my Genevieve!
She loves me best whene'er I sing
The songs that make her grieve."

"We look before and after,
And pine for what is not;
Our sincerest laughter
With some pain is fraught:
Our sweetest songs are those which tell of saddest thought."

Few, we think, would judge Shakspeare to have been a plagiarist of the grand passage in his work—

"The man that hath no music in himself," &c.

And yet an ancient Welsh bard thus depicts the same thought—

"He who loves not tune nor strain,
Nature to him no love has given;
You'll see him, while his days remain,
Hateful at once to earth and heaven."

The following instance we extract from one of John Foster's aphorisms in his life by Ryland:—

"One should think that a tender friendship might become more intimate and entire the older the parties grew,—as two trees, planted near each other, the higher they grow, and the more widely they spread, intermingle more completely their branches and their foliage." (N.B.—This was absolutely my *own* conception; but I found the very same idea lately in Ramsay's Gentle Shepherd:)—

"But we'll grow auld together, an' ne'er find
The loss o' youth, when love grows on the mind.
See yon twa elms, that grow up side by side,—
So please them, some years syne, bridegroom and bride;
Nearer and nearer ilka year they've prest,
Till wide their spreading branches are increased:
An' in their mixture now are fully blest.
This shields the other frae the eastlin blast,
That in return defends it frae the wast."

The foundation of the very pretty thought, the embodiment of which thus has been properly ascribed to Chesterfield, and erroneously so to Sheridan and others—

"The dews of the evening be careful to shun.
They are the tears of the sky for the loss of the sun,"

may be found in Milton:

"Sky lowered, and, muttering thunder, some sad drops
Wept at completion of the mortal sin."

We have, indeed, met with the same idea in other writers. Jeremy Bentham had a peculiar mode of thinking, and launched out occasionally some splendid conception, which was caught up without due consideration, and twisted into that wreath of fame with which his admirers loved to bind his brow. To how much he was indebted for the following to Bacon, we know not. We do know that he venerated his memory largely. Bentham, in his Book of Fallacies, says—"What in common language is called old time, ought (with reference to any period at which the fallacy in question is employed) to be called young or early time." Bacon, in his Advancement of Learning, says—"To speak truly, *antiquitas sæculi juventus mundi*. These times are the ancient times, when the world is ancient, and not those which we account ancient, *ordine retrogrado*, by a computation backward from ourselves." He repeats this truth more solemnly and at large in the *Novum Organum*, Aph. 84:—"The opinion which men cherish of antiquity is altogether idle, and scarcely accords with the term. For the old age and increasing years of the world should, in reality, be considered as antiquity; and this is rather the character of our own times than of the less advanced age of the world in those of the ancients. For the latter, with respect to ourselves, are ancient and elder; with respect to the world, modern and younger."

In some cases we find a forcible expression used, which is afterwards slightly or greatly improved. Here the merit of invention is the more justly due to the author of the last. Instances are too numerous to require illustration. And, indeed, we must begin to look at the matter on more important points; but our space, like life, is short; and the art upon which we are exercising ourselves, like all art, is long.

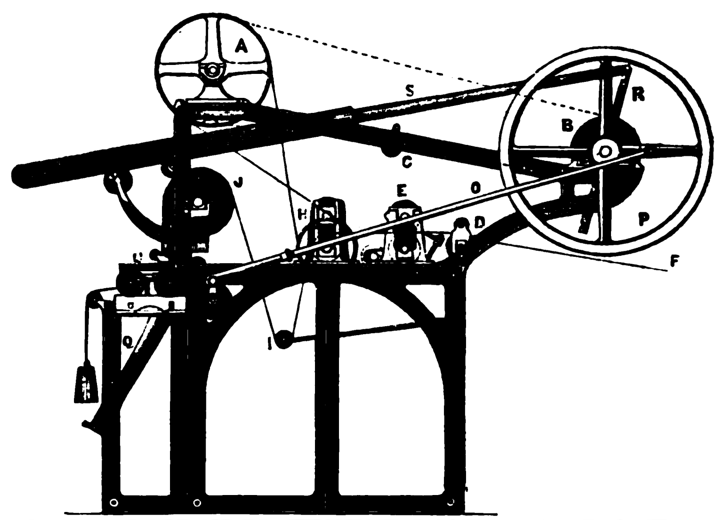
The subject of this paper is, of course, inexhaustible. Many far more general matters might be observed upon, and lead us to the conclusion at which we would arrive. That conclusion must now be left to be gleaned by those of our readers who have given some attention to what we may have said. At some future time we may recur to the topic.

TIDCOMBE'S CONTINUOUS SHEET PAPER-CUTTING MACHINE.

This machine, the invention of Mr. George Tidcombe, of the Watford Iron Works, is intended for cutting paper to the required width and length, as it issues direct from the paper-making machine, or as it is removed from the holding reels. As arranged in the present instance, the machine is fitted with three rotatory cutters—a central one for severing the web into two equal parts, and two side ones for cutting the edges to regular lines; whilst a fourth cutter, or transverse knife, severs the web into proper lengths.

Fig. 1 is a side elevation of the machine, and fig. 2 is a plan. It is worked by a pair of cast-iron cone drums, A, B, and a screw between

Fig. 1.



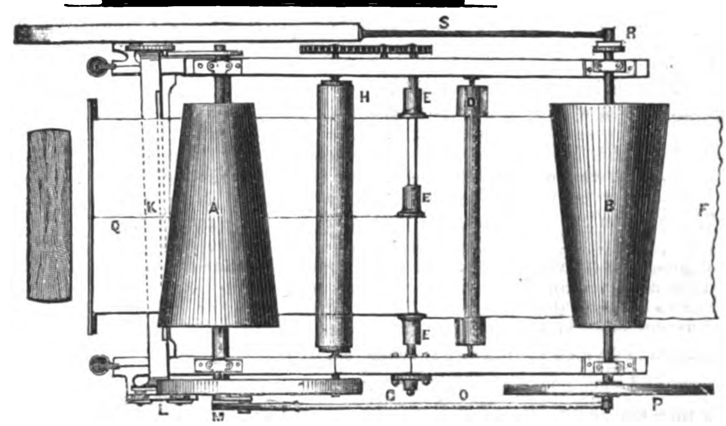


Fig. 2.—1-32d.

them at C; the extent of the whole width of the machine regulates the strap and speed required. As the paper is to be cut longitudinally, it is conducted through a pair of rollers, D, previous to entering a double row of circular cutting knives, E, E, for that purpose. These knives are so formed as to cut on the scissor principle, as may be seen in fig. 2, where the continuous sheet of paper is being cut at the edges, and slit in the middle, there being another row of circular knives beneath the sheet of paper, F, working against the sides of each other. A species of curvilinear or spiral slot arrangement at the end, G, of the top knife

spindle, adjusts and keeps them in their places, or, in other words, "up to their work."

The sheet is then led through another pair of iron rollers, H, and thence, by a dancing roller, I, to a felted drum, J, high up in the machine, so as to cause it to descend perpendicularly for being cut transversely. The knives which then cut the sheet at K, are two blades of steel as long as the width of the machine, worked also on the principle of a pair of scissors, beginning the cut at one end. The top knife being a fixture, the bottom one is mounted on a pair of wheels at each end, moving backward and forward on a train, L, by a crank, M, a pulley and strap connecting the axle, N, and which crank is moved by the arm, O, from the fly-wheel, P. The reverse action is given to the knife by a pair of weights and pulleys at the front. The paper is now cut into sheets, and a boy receives them at Q.

The arm and link, R, S, are attached to the cone drum spindle, and are for the purpose of regulating the length of sheet required. The arm, R, slides up and down the boss at its centre, being thereby made a long or short crank. On the spindle of the drum, J, on the same side of the machine as the arm, S, is a ratchet-wheel of the same diameter as the drum. This arm, S, when on the ratchet-wheel, moves the sheet down, and when the throw of the crank in its motion stops the sheet, it runs on the pulley, T, set on a lever, the other end of which catches against the under side of the ratchet-wheel, and holds it till the sheet is cut, and the arm, S, makes another stroke. At U is a stop-board as long as the width of the machine, and at every motion of the train-knife, K, on the wheels, N, it holds the sheets while they are being thus cut transversely, and is kept close up to the knives by spiral springs, one of which is at each end of the machine.

This machine cuts very accurately. It is simple in construction, and is being generally used by many of our first paper-makers.

A DIALOGUE ON THE RATIONALE OF PERMANENT WAY,

Between a Railway Director and an Observer.

Director.—What *is* the best permanent way, in your opinion?

Observer.—*Permanent* way does not exist as yet; the term is a misnomer.

D.—What gave rise to the term?

O.—Contractors use *temporary way* in the making of railways, and they remove this temporary way, leaving some other, which shareholders fondly hope may be permanent, but which is not so, but commonly very transient.

D.—It is a desirable thing to have permanent way. Is not that within the province of mechanical art?

O.—In what sense do you mean?

D.—In the sense of having a way made which will not be continually wearing out, and running away with our profits in the shape of "maintenance."

O.—This is perfectly practicable.

D.—Then why do we not possess it?

O.—Because effect follows cause. The railway is either too weak for the loads that run on it, or the loads are too heavy for the road.

D.—But we must have the loads. We must transact our business.

O.—That cannot be accomplished by breaking down your road. There is a maximum strength of road which cannot be exceeded. Nature has provided a limit, by the capacity of materials, to resist crushing. Beyond this you cannot go. If, when you have made the best practicable road, you find it crushing, you must reduce your loads.

D.—What is that limit?

O.—The ultimate resistance of iron, timber, stone, ballast, or other material of which the railway is composed.

D.—Will you explain more clearly?

O.—The understructure is composed of stone, or timber, or metal, called sleepers, laid upon the earth, or upon sand or gravel, artificially spread upon the earth, and called ballast.

D.—What is the object of the ballast?

O.—To interpose a porous stratum, for the purpose of drainage, and bedding the sleepers, where the natural formation is clay or rock, or too soft or loose a soil.

D.—What is the true understanding of the term "sleeper?"

O.—In buildings it means an immoveable mass in one piece, of stone, or timber, or metal, buried in the ground, as a foundation for a superstructure to rest on. It is called a sleeper because it does not move.

D.—Wherein do railway sleepers differ from this description?

O.—That they are constantly in motion beneath the trains, and do not "sleep" at all.

D.—What evidence is there of this?

O.—The clouds of dust in dry weather, the oozing of mud in wet weather, and the constant labour of repacking the ballast below them.

D.—From what cause does this arise?

O.—From want of sufficient weight, and area of bearing surface.

D.—It occurs to me that we do not put ballast under the foundations of a wall, unless in the form of concrete. Would it not, therefore, be practicable to dispense with ballast in the railway?

O.—Undoubtedly, if the sleepers were sufficiently solid and firm not to move.

D.—Yet the stone sleepers formerly used were heavy and solid enough, and still were not found to answer.

O.—They were not of a good form to begin with. Each sleeper contained four cubic feet of stone. It had four superficial feet of area bearing on the ballast. Had they been only six inches thick, instead of twelve, there might have been eight superficial feet of area to each stone. That would have doubled the availability of the material without increasing cost.

D.—Was this injudicious form the cause of their failure?

O.—It was a reason for their being less steady, and it added to the expense of getting at them to pack them up when subsidence took place. But the great objection arose from the impossibility of keeping the iron chairs fast on the stones by the methods used.

D.—What do you consider the best material for the sleepers?

O.—That must vary with the locality. Chemically, the most durable is stone. Cast-iron may answer very well, if the form be good and the price will afford a sufficient mass of it. Wood, also, is a very good material.

D.—Does not experience point out that there is no chemical durability in wood—that it rots rapidly?

O.—That depends on the quality of the wood, and the mode of its appliance. If mere sap-wood be used, green and unprepared, it may rot in two or three years. Mass, also, has much to do with the question. If the sleepers be small, so that they bend and spring, the fibres are separated, water gets in, and they are destroyed. Timber may be destroyed both chemically and mechanically.

D.—But there are chemical means of rendering it durable?

O.—Yes; it may be injected with chemical salts, soluble in water; but, as they may be washed out again by water, this is of little use. The true way is to inject with resinous or oily material, and thoroughly saturated with this, the timber may remain uninjured as long as trees in peat-bogs.

D.—Still stone would be better, or cast-iron?

O.—In some cases, if cost be not too heavy. But a perfectly efficient road might be made with timber sleepers.

D.—Transverse or longitudinal?

O.—Longitudinal. With the same amount of timber, efficient bearing surface of 37 feet on the ballast can be obtained with the longitudinal system, while, on the transverse system, only 26 feet can be obtained.

D.—Do you mean that a road could be thus made which would not require maintenance?

O.—That would depend on the quality and quantity of the material, and the amount of the load. If all were in proper proportion, such a road ought to last, with scarcely any annual expense, for twenty years.

D.—I understand you, that the most durable sleepers are stone blocks, but that no means exist of securing rails to stone blocks?

O.—Means exist, but have not been as yet used. Longitudinal timbers, laid on stone blocks for the rails to rest on, would be a perfectly durable way.

D.—Would this method be better than timber alone?

O.—Timber alone would require to be in much larger mass. You comprehend that there requires to be a very solid foundation beneath the rails, and that the rails should be firmly attached to this foundation. Hitherto the foundations have been insufficient.

D.—How, then, would you propose to make the most perfect permanent way?

O.—By laying, first, a continuous line of flag-stones, from four to six inches thick, and from two feet to three feet wide under each rail, firmly bedded in the ground or ballast. On this a longitudinal balk or balks, bolted between the joints of the stones to small wood blocks below, the wood being all creosoted, and the whole rendered one continuous length.

D.—And on this you would fix your rails, with chairs, in the usual way, or bolt down a bridge rail?

O.—Neither one nor the other. The rail requires as much consideration as the sleeper.

D.—If you have a sufficient foundation, will not that efficiently support the rails?

O.—If the rails and sleepers be one entire structure, or the rails be

accurately fitted to iron sleepers, it might do; but, whatever be the arrangement, it is absolutely necessary that the rail be so stiff, both vertically and laterally, as not to deflect beneath any load that may go on it; and, moreover, that the joints be so reinforced, that they be equally strong and unyielding as the other parts of the rail.

D.—In what way does this deflection act injuriously?

O.—It is the primary source of deterioration and expense in maintenance. As thus, to prevent yielding under the load of an engine, it is essential that there be a certain amount of sleeper surface bearing on the ballast. If this be a distributed pressure, by the rigidity of structure the ballast will not yield; but if the rail deflect, unequal pressure obtains, and the ballast is crushed in detail every time the engine passes over it, and continuous reparation is required.

D.—Are none of the existing rails sufficiently inflexible?

O.—Not for the existing weights. The double I rail is flexible laterally, and insufficiently stiff vertically. The bridge rail is stiff laterally, and flexible vertically. The result is, that in deflecting vertically it crushes the timber in detail. The timber also deflects and crushes the ballast in detail. Therefore it may be established as a canon in the maintenance of way, to provide nondeflecting rails of an efficient girder form.

D.—Then you would require much heavier rails?

O.—There is metal enough in many of the existing rails were it better disposed. There are three existing forms of rail. The double I used with a chair, which raises the rail, and gives a mischievous leverage to the side lurch of the engine; the bridge rail, with a broad, flat foot, used without a chair; and the foot rail, which is a single ⊤, with the lower portion formed into a broad flat foot. This foot rail deflects vertically, and involves destruction. But if this foot rail be converted into a rigid girder, cruciform in section, by being rolled with a deep thin web below, and the joints be efficiently connected with cheek plates, there will be no deflection, and, consequently, no expense of maintenance.

D.—But how will you fix this rail?

O.—By dividing the longitudinal balk into two halves, placing the lower web of the rail between them, with the horizontal portion resting on their upper surfaces, and bolting them together laterally.

D.—But if stone were too dear, or not to be obtained, how then?

O.—Slates, or cast-iron plates, might be used; or a round log of fir, 16 inches in diameter, divided into four parts, would form longitudinal sleepers, giving nearly 20 feet of bearing surface in the ballast for each rail length.

D.—But would not the wood crush?

O.—Not if the rail were an inflexible girder.

D.—And you think this would be a really permanent way, not requiring maintenance?

O.—Undoubtedly; unless crushed by an irrational load.

D.—What would be an irrational load?

O.—The best iron begins to crush with a pressure of eleven tons to the square inch. Rail iron does not bear more than eight tons. The impact of a driving wheel of 5 feet diameter on a round topped rail makes an impression at four tons. A flat-topped rail, hardened by rolling, might perhaps bear six.

D.—I think I know of instances of rails down for more than seven years carrying greater weights.

O.—Yes; but those rails have been deflecting in the ballast, avoiding the direct pressure, at a great loss of engine power. Had they been laid on unyielding stone blocks, they would have been crushed.

D.—And if great loads *must* be drawn, what is to be done?

O.—In the first place, the engine will probably be found to develop one-third at least more available power on a nondeflecting rail. If more power still be required, the rail must be widened to three or four inches, and the surface steeled.

D.—Would not the wheels slip on account of the hard surface?

O.—I think not. Slip is caused by a yielding or deflecting rail beneath the driving wheel. A rigid rail would be less disposed to produce slipping.

D.—And you think this is the only plan of producing really permanent way?

O.—Not so. Many modes may be used, but all must be on the principle of a nondeflecting rail, with sufficient bearing surface not to crush the sleepers, and sufficient bearing surface in the sleepers not to sink into the soil or ballast, and of a material not subject to rot; if of cast-iron, in sufficiently large masses not to break like biscuit.

D.—But may not the rails be of one single piece of wrought-iron, of sufficient bearing surface not to require sleepers at all.

O.—Yes; but we must first improve our rolling mills; and, in this case, the cruciform section before described, simply enlarged, would be the best. A rail might thus be made solid, but there would be disadvantages in it.

D.—Of what kind?

O.—If the surface were worn out, there would be a very large mass to remove and replace. It would be more economical to have the wearing surface removable. A very simple arrangement would accomplish this. Two plates of wrought-iron, each bent to a right angle, and bolted together back to back in the form of a ⊤, would make a very firm girder. They should be bolted "break joint," *i. e.*, the joints on one side should be connected to the solid portion of the other side. On the centre of the top, covering the joint, should be bolted a foot rail, and the whole should be connected by tie rods.

D.—Of what size would this girder rail be?

O.—The horizontal bearing surface should be for heavy work about 18 inches in width, the vertical depth about 9 inches, and the rail about 1¾ inch above the bearing surface. Thus, the vertical web would form a deep keel in the ground, preventing lateral movement, and the packing would be very firm and solid.

D.—But would it hold firm in the ballast?

O.—By means of its keel it would hold much firmer than mere surface sleepers; but bolting a piece of timber to the edge of the lower web would key it down very firmly.

D.—And you think this would be a perfect railway?

O.—I prefer the stone, timber, and iron.

D.—But either of these methods would be costly?

O.—And is it not costly to pay away fifty to eighty pounds per mile per annum for labour in maintenance, and much more in waste of engine power?

D.—True; is there any other point?

O.—Yes; the keeping your way in an exact state of moisture, between wet and dryness, as the highway people do. Depend upon it that dusting your passengers is a very costly process to the shareholders.

D.—And how may this be done?

O.—It is a very possible thing to make the rail a hollow girder of wrought-iron, perforated to admit and carry off water; and it might serve to conduct water to moisten the way in dry weather.

D.—Would not these iron rails without timber be noisy?

O.—Very likely; but it would be possible so to construct the rail, that, while nondeflecting, it might yet be elastically supported on the girder, preventing noise, and diminishing vibration—yet, remember, without any deflection tending to disturb the foundation on the ballast. *Deflection is only another word to express waste in maintenance.*

D.—You have given me much subject for thought. But what you have told me sounds very like common sense. It is quite clear that I must find time to think, before going farther with the present system. Wise outlay is the truest economy. We will talk again on this matter.

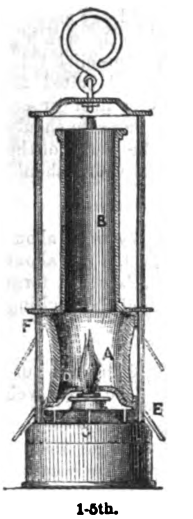
ELOIN'S MINER'S SAFETY-LAMP.

Although admirably suited for the hazardous work of testing dangerous workings, it has long been matter of notoriety that the ordinary Davy lamp is both dangerous and inconvenient in its every-day employment for the regular work of the miner. Its chief defects are:—Deficient light, rendering the collier always unwilling to use it, unless compelled by the presence of a highly explosive atmosphere. Liability of injury to the gauze of the cylinder, either by a blow or a fall to the ground. The possibility of a current of explosive atmosphere being carried through the gauze cylinder, either by the swinging of the lamp in the hand of a person when walking, or by its being exposed to the powerful *blowers of gas*, which are sometimes given off with great force. The heating to redness of the gauze, by which explosions actually take place, not from the passage of flame through the gauze, but by the actual contact of the explosive atmosphere with the heated wire. This danger is often increased by the presence of small particles of coal dust, which, floating in the air of the mine, attach themselves to the gauze; and also from the deposit of *soot on the gauze*, arising from the imperfect combustion of the oil, which in the common Davy lamp always gives off a dense column of smoke.

As an attempt at a remedy for these defects, M. F. Eloin, a Belgian mining engineer, has proposed to us the new arrangement of lamp which we have depicted in our engraving. This figure represents a vertical section of the lamp as in use.

The cylinder, A B, above the flame, is closed, and air is admitted only *below the flame*, through a narrow breadth of gauze, C; but the air which is admitted is brought into actual contact with the flame, by the application of the cap, D, on the principle of the solar lamp; and thus perfect combustion is produced, giving off light equal to at least five or six ordinary Davy lamps. The light produced is one which the

collier would prefer to that of any candle, from its greater intensity. From the perfect combustion of the oil, no *smoke* whatever is given off. Injury to the gauze is obviated by using, first, a strong short cylinder of glass, A, through which the light passes, capped above the flame with a brass or iron cylinder, B, which cannot be injured, except by actual violence. It might be supposed that the glass portion of the cylinder would be liable to accident, but in practice this is not found to be the case: bound, at top and bottom, by a strong brass ring, if it were even to crack, either from a blow, or from unequal expansion by heat, no danger would result, as the pieces into which it would be separated would still be held together by the brass beadings. The closed nature of the cylinder entirely prevents the passage of an explosive atmosphere into the lamp by any current of air; no swinging of the lamp causes any action on the flame; and no blower of gas can blow into the flame, in consequence of the protection of the cylinder. All danger by the heating to redness of the wire gauze is entirely removed.



1-5th.

The air which enters through the narrow breadth of wire gauze, *below the flame*, being only such as is necessary to support the flame of the wick, and the combustion being of so perfect a character, that portion of the cylinder which is above the flame must always be filled with the products of combustion, and never with an explosive atmosphere. In the ordinary Davy lamp there must always be a tendency in the surrounding atmosphere to rush through the wire gauze into the lamp, and to fill it, more or less, with the atmosphere of the mine, whatever that may be. In M. Eloin's lamp the contents of the cylinder above the flame must always be the products of combustion. This is clearly seen by the flame being extinguished whenever the general upward current is by any means reversed. So confident is M. Eloin of the action of his lamp in this respect, from his experience in the Belgian mines, that he has placed a very coarse wire gauze over the top of the lamp, simply for the purpose of preventing any particles of coal or dirt from entering, but of a width that would readily allow the passage of flame, if any flame could be supported in the upper part of the cylinder.

A conical brass shade, E, is attached to, and made to slide upon, the rods surrounding the glass portion of the cylinder, by which the light can be directed downwards if wished, so as to throw the light over the floor of the mine when the shade is moved up, as shown by the dotted lines at F.

GENERAL VIEW OF TRIGONOMETRY,

DERIVED FROM GEOMETRICAL PRINCIPLES BY ANALYTIC ARTIFICE, AND MADE SUITABLE FOR THE CALCULATIONS OF THE PRACTICAL MAN.

By J. G. B. Marshall, B.A., C.E.

II.

It is the more immediate practical object of Trigonometry to calculate and compare the magnitudes of angles. The solution of all the cases of plane triangles then becomes very simple; the angles being known in terms of the sides which can be measured, and *vice versâ*. In fact, these solutions will serve as excellent illustrations and practical examples of principles capable subsequently of much more extensive application to higher mathematics and physical sciences.

In plane trigonometry, the angles are supposed to be formed by the mutual inclination of *right* lines, or to be *rectilinear angles*, lying in the same plane, in contradistinction to spherical trigonometry, in which the angles are contained by circular arcs, are solid angles, &c. The lines containing the angle bear no relation to it, and, consequently, cannot be used as standards in measuring it. Some lines subtending it must be sought; and it has been shown that the circle possesses properties which admirably suit it for this purpose.

It has been proved by the usual geometrical method, that angles at the centre of a circle are directly proportional to the arcs subtending them; the converse also follows; and, besides, a law has been established for connecting angles at the centres of different circles, *i. e.* of circles of different radii, by which they may also be compared. Now, as an angle, from being acute, increases, the arc subtending it also increases till it becomes a semicircle, when the angle becomes equal to two right angles, or vanishes. This is a failing case in Euclid's demonstration, an absurdity in the proportion which recurs as often as the angle vanishes, when by revolutions it successively assumes values equal to an even number of right angles.

The following general proof includes this and many other cases, and obviates this apparent difficulty and absurdity:—

Proportion expresses the relation among magnitudes which exists when the multiples or submultiples of one lie at the same intervals among those of a second of the same kind, as the corresponding multiples or submultiples of a third do among those of another (a fourth) of the same kind as itself. When these are mere abstract numbers, the idea of kinds does not come in question. Now, in the case of arcs and angles, they are mutually proportional; for if we cut off from the greater arc a part equal to the less, we must simultaneously cut from the greater angle a part equal to the less. When an angle is said to be "of" a certain number of degrees, &c., the meaning is, that when a circle is described round it as centre, the arc included between the lines containing that angle, produced, if necessary, to the circumference, contains the given number of degrees, &c. Thus, then, a standard is supplied for measuring and comparing angular magnitudes, but arcs themselves are very difficult to measure and compare to rectilinear standards. To effect this, and thus supply the only desideratum in trigonometry, must form the next subject of investigation, to which we proceed directly, observing that the necessary analysis includes principles of the greatest beauty and importance in relation to the higher mathematics and abstract sciences, besides its use in resolving all the cases of triangles, which furnishes a capital exemplification of the method of obtaining practical results from merely theoretical deductions, and of the application of abstract principles to a particular purpose.

In the early stages of the growth of this science, chords (inscriptæ) were used as measures of arcs. The peculiar coincidence between the radius and the chord of a certain arc (60°), we have seen, caused its adoption as the standard or unit from which all the divisions of the circle were taken. This method of chords was soon abandoned, and certain lines, drawn in and about the arc, substituted. From the relations existing among these, formulæ and series were sought and established by analysts inquiring after abstract truths, and applied by each practical man to the exigencies of his particular case.

The figure (No. 1) presents these lines, which may be defined as follows, some of their most interesting and simple relations being, at the same time, noticed, and forming the axioms on which the subsequent deductions are founded; besides, any one will be able to observe, that all the cases of the right-angled triangle, which are exceedingly simple and elementary, are included in these illustrations:—

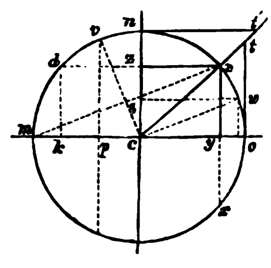


Fig. 1.

Let $o\,x\,m$ be any circle, $o\,c\,x$ any angle at its centre, subtended by an arc, $o\,x$, commencing at o, which is therefore called *the origin*, and increasing or decreasing towards x, m, &c., as the angle increases or decreases by the moving of $c\,x$.

The complement is the arc $(x\,n)$ which, when added to $o\,x$, makes it terminate one quadrant, or 90°, from the origin.

The supplement $(x\,m)$ is the arc which, when added to $o\,x$, causes it to terminate two quadrants, or 180°, from the origin.

The complement need not be $(90°-o\,x)$, nor the supplement $(180°-o\,x)$; but any given number of times the circumference added to these quantities, gives the complement and supplement respectively. Hence, if π denote a circumference, the complement is $0\cdot\pi+90°-o\,x$, or $1\cdot\pi+90°-o\,x$, or $2\pi+90°-o\,x$, &c.; and the supplement is $0\cdot\pi+180°-o\,x$, or $1\cdot\pi+180°-o\,x$, or $2\pi+180°-o\,x$, &c.

The sine $(x\,y)$ is the perpendicular, drawn from one extremity (x) of the arc $(o\,x)$ to the diameter $(o\,m)$, passing through the other (o).

The sine is half the chord $(x\,x')$ of the arc $(x\,o\,x')$, which is double $o\,x$ (Euclid, 3. 9.); and hence its name is derived, S. In., or Semiss. Inscriptæ.

The sine of any angle = the sine of the supplement of that angle; thus, sine 30° = sine 150°, each arc being reckoned from the origin, and the perpendicular drawn 150° from o, is the same as 30° from m.

The cosine $(c\,y)$ (or sine $x\,z$) of the complement $(x\,n)$ is the part of radius intercepted between the centre (c) and the end (y) of the sine.

The arc $o\,x+$ (its supplement) $x\,m=180°\;\therefore$ half $(w\,v)$ this sum $=90°$, *i. e.* half $(v\,m)$ the supplement of an arc is the complement of half $(o\,w)$ the arc $(o\,x)$, wherefore the cosine $(w\,q)$ of half an arc is equal to the sine $(v\,p)$ of half the supplement of that arc, and *vice versâ*. These relations should be carefully noticed and remembered, since they are to

be used in subsequent deductions. It has been seen that half the chord of any arc is the sine of half that arc; hence, the cosine of half an arc is equal to half the chord ($x\,m$) of the supplement ($x\,n\,m$) of that arc ($o\,x$), and *vice versâ*.

(Euclid, 1, 47.)—If c denote the cosine, s the sine, and r the radius, $r^2 = c^2 + s^2$, hence any two of these quantities being known, the other may be found. Let $r = 12$ feet, and $s = 6$ feet, which, we know, is the sine of an arc of 30°. Since the chord of $60° = r = 12$ feet, and sine $30° =$ one half of the chord of $60° \therefore 144 = c^2 + 36 \therefore c = \sqrt{108} =$ 10·4 feet, nearly = the cosine of 30° to radius, 12 feet.

The arc of 30° is the complement of 60°; hence the cosine of 60° = sine of 30° = one half of the radius; and hence the student can find the sine of 60° to any given radius, such as 10 feet. Find the chord, &c., of an arc of 120°.

120° is the supplement of $60° \because 60° + 120° = 180° =$ one semicircle. But 60° = one-half of 120° = one-half this supplement $\therefore$ half the chord of 120° = sine of 60° = cosine of 30° $= \sqrt{\cdot 75} \times$ radius $= \cdot 86 \times r$. By varying the value of r, and calculating all the other lines here named, the student will learn to apply and become familiar with the general truths stated above, and see their illustration in a particular case, which will hold true of any arc when any one trigonometrical line has been determined for it.

The *tangent* ($o\,t$) is the perpendicular drawn from the extremity (o) of the radius, to meet the radius ($c\,t$) produced through the other extremity (x). Call it t. When c, s, and r, are known, t can be found by similar triangles (Euclid, 6, 4). Thus, $c : s :: r : t$; or in the case of an arc of 30°, when $r = 10$ feet.

$8{\cdot}6 : 5 :: 10 : t = 5{\cdot}8$, &c. feet = the tangent of 30° to radius 10 feet.

For practice, find the tangents of 30°, 60°, &c. When the radius is 1 foot, 5 feet, &c. When $r = 1$, tangent = sine ÷ cosine $= \frac{\text{sine}}{\text{cos.}}$, from the proportion, an equation which should be borne in mind.

Sine, cosine, and tangent of 45°, may be found from the relation that sine 45° = cosine 45° $= \sqrt{\tfrac{1}{2}r}$.

The *secant* ($c\,t$) is the line made up of the radius and its production to meet the tangent. When the radius and tangent are known, it may be found. (Euclid, 1, 47.)

If $r = 10$ feet, and tangent = 5·8 feet = tan. 38°, find secant $= c\,t$, $t^2 + r^2 = c\,t^2 \therefore c\,t = 11{\cdot}6$, &c., feet.

Or when the cosine and radius are known, $c\,t$ may be found (Euclid, 6, 4) from similar triangles, $\because$ cos. $: r :: r : c\,t$; or, in our case, $5 : 10 :: 10 : c\,t = 11{\cdot}6$ feet, &c. So also $c\,t$ might be found from the tangent, sine, and radius, and should be practised, $\frac{r^2}{\text{cos.}} =$ sec., &c.

The *cotangent* ($n\,t'$), *cosecant* ($c\,t'$), &c., are the tangent, secant, &c. of the complement; and the relations pointed out above apply to them, and should be carefully worked out for various assumed radii and arcs.

The *versed sine* ($y\,o$) is the difference between the radius and cosine, and the *subversed sine* is the same for the complement, or the difference between the radius and sine.

The student can now easily perceive, that when any one trigonometrical line is known for an arc of given radius, any or all of the others can be calculated from similar triangles, &c. Not only is this the case when any, or all, of these lines are known for an arc of a given radius, they can, by equally simple calculations, be determined also for any different radius, while the arcs remain the same, or continue to contain the same number of degrees. Thus (see fig. 2) the cosine of an angle or arc of 30° is ·86 foot when radius is 1 foot, 8·6 feet when radius is 10 feet, 86 feet when radius is 100 feet, and so for any other radius. Similarly also any other line, as tan. 30°, might be found for assumed radii—5 feet, &c.

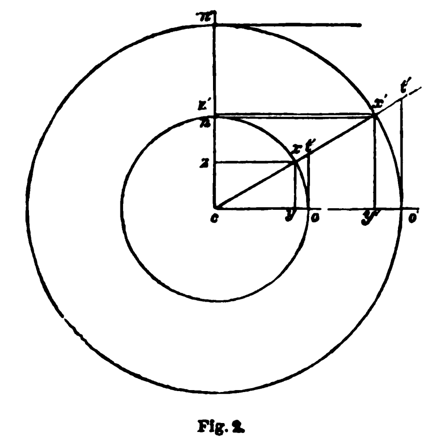


Fig. 2.

It is sufficient, therefore, to find the trigonometrical lines for the case of one radius, as 100, or 1 foot; for in general any line of one circle is to the similar line of another, as the radii of this circle, as in fig. 2, $o\,t : o'\,t' :: o\,c : o'\,c$, and $c\,y : y\,x :: c\,y' : y'\,x'$; hence, when one ($x\,y$) is known, the other ($x'\,y'$) can be found if the radii are given.

When formulæ and series are found to express relations among trigonometrical lines in terms of radius, taken as unity, they may be adapted to the case of any other radius by merely introducing the new radius in such a manner as to render the formulæ, &c., *homogeneous*.

Homogeneity of Formulæ, &c.—The student will best comprehend the necessity of making the terms of a formula homogeneous, by reverting to the origin of the expression. The terms of an algebraic expression are said to be homogeneous when they have the same number of *dimensions*, and this idea of dimensions accompanied this science out of geometry. As it is absurd to speak of adding together or subtracting magnitudes of different dimensions, as lines and surfaces, or solids, so also quantities of higher dimensions must be assimilated before they are capable of combination by signs of addition or subtraction. As an example in trigonometry, intended to point out to the student the manner of effecting this condition—sine $(\omega + o)$, *i. e.* the sign of an arc, which is a line, is said to be equal to sine ω cos. o + cos. ω sine o, which denotes the sum of the products of lines multiplied together, or of two rectangles; which is absurd till the introduction of the radius as a factor of the former member of the equation, makes it homogeneous with the latter. In general, terms are homogeneous when the sums of their indices are equal; thus, x^4 and $y^3\,x$, $y^2\,x^2$, $y\,x^3$, are all homogeneous, because 4, 3 + 1, 2 + 2, and 1 + 3, are all equal.

If x and y represent two lines, x^2 represents an area, and so does $x\,y$; consequently x, a line, could not be added to either of these areas; and similar impossibilities arise among quantities expressed by higher dimensions, and hence the necessity of homogeneity.

The next preliminary step is to obtain some *criterion* of *signs*, by which these trigonometrical lines may be connected together, for all or any values of the arc x. In what follows, the arc will be denoted by x, the radius taken as unity, and o as the origin.

The criterion of signs generally used in this, as in some other analytic and higher abstract sciences, is, that every quantity shall *change* its sign from + to —, or *vice versâ*, in passing through either of the values, *zero* or *infinity*. Without waiting to discuss the introduction, history, or efficiency of this rule, we proceed to illustrate its application to our purpose.

When $x = o$, the sine and tangent are also equal to nothing, the cosine and secant are = 1; and the cotangent and cosecant are infinite (Euclid, 1, 12th axiom). When x changes its value, these lines vary simultaneously. Let us suppose them all positive, or that the sign + precedes each of them for any value of x between the origin and 90°, or the end of the first quadrant, and then apply our criterion. As x increases they change, till at $x = 90°$, or (any number of times $\times \pi$) + 90°, the sine = 1, the cosine and cotangent simultaneously vanish, and therefore change signs, because the complement of x (= 90°) is nothing, and the tangent and secant become infinite (Euclid, 1, 12th axiom), and, therefore, also change their signs. As x still farther increases, new changes take place, and when $x = 180°$, or any value which makes it terminate 180° degrees from the origin, the sine and tangent again vanish, or are equal to 0, and therefore become negative; the cosine and secant are equal to 1, and the cotangent and cosecant are infinite; and, therefore, now also change signs, and become positive again, &c. &c.

All arcs which end between 0 and 90° have all their trigonometrical lines positive.

All arcs which end between 90° and 180° have positive signs and cosecants; all other lines negative.

All arcs which end between 180° and 270° have positive tangents, secants, and cotangents, and negative sines, cosines, and cosecants.

These relations may be expressed by formulæ, π denoting 360° or 1 circumference.

If x denote any arc, sine $x =$ sine $\frac{\pi}{2} - x$ or sine $180° - x$, while x is less than 90°, and this is true also for any number of times π; and these are all positive sines, since the arcs to which they belong all terminate between 0 and 180°.

So, also, sine $\left(\frac{\pi}{2} + x\right) =$ sine $(\pi - x)$ or sine $(180° + x) =$ sine $(360° - x)$, and both are negative.

In general, if n denote any number in the series 0, 1, 2, 3, &c., the formulæ $n\,\pi + x$, and $(n + \frac{1}{2})\,\pi - x$, express all arcs having positive sines; the sine of an arc denoted by either formula being the same as long as x remains the same.

For similar reasons, all arcs having the same negative sines are comprehended in the formulæ $(n + \frac{1}{2})\,\pi + x$, and $(n + 1)\,\pi - x$.

In like manner, all arcs which have the same positive cosines are expressed by the formulæ $n\pi + x$ 1 $(n+1)\pi - x$; those with the same negative cosines are comprised in $(n+\frac{1}{2})\pi - x$, and $(n+\frac{1}{2})\pi + x$. The memory will be assisted by observing that all sines lying above a diameter drawn from 0 to 180° are positive, all below it negative; and that all cosines lying to the right of a diameter drawn from 90° to 270° are positive, all to the left of it negative.

Arcs having the same tangents are expressed by the formulæ $(n+\frac{1}{2})\pi - x$, and $(n+1)\pi - x$, when they are *negative*, and by $n\pi + x$, and $(n+\frac{1}{2})\pi + x$ when they are *positive*. When the tangent is infinite, the cotangent is zero, and *vice versâ*. Hence they change signs simultaneously, and therefore the same formulæ serve for both, and they change signs as frequently as they change quadrants, from 0 to 90° positive, from 90° to 180° negative, from 180° to 270° positive, &c. &c. &c.

The cosecant varies like the sine, and the secant exactly like the cosine, and hence they are respectively comprised in the formulæ for those lines.

It is equally simple to express the submultiples, the halves, thirds, &c., of the arcs, when these submultiples continue to have the same sines, cosines, &c., but it would only multiply formulæ which the student does not much require, or can make out for himself.

The trigonometrical lines may all be determined for the following arcs by geometrical relations. When $r = 10{,}000$ feet, inches, or &c. (units):

(Euclid, 1, 47.)—Sine 45° = cosine 45° = 70 71 units, or when $r = 1$, sine 45° = cosine 45° = $\sqrt{\frac{1}{2}}$ = ·70, &c.

(Euclid, 3, 9, &c.)—Sine 30° = cosine 60° = half the chord of 60° = one half of radius = 5,000 units, or to $(r = 1) = \frac{1}{2}$.

(Euclid 1, 47.)—Cosine 30° = sine 60° = 8,662 units, or when $r = 1$ sine 60° = $\sqrt{\frac{3}{4}}$.

From these the student can find the tangents, &c., for these radii, and for a few others for practice. He should also bear in mind these values. The sines, &c., of a few other arcs may also be directly obtained from radius by the intervention of the following properties, which we shall demonstrate fully:—

The side of a regular decagon, inscribed in a circle, is the chord of an arc of 36°. Hence half that side is the sine of an arc of 18°. But the side of the regular inscribed decagon may be proved to be equal to the greater segment of the radius, when it is cut *medially* (Euclid, 2, 11), or so that the rectangle contained by the whole, and one part is equal to the square of the other part, or that the whole is to one part as that part is to the other.

Let $a\,b\,c$ (fig. 3) be any circle described with o as centre, and the triangle $a\,b\,c$ inscribed in it, as in Euclid, 4, 11, $b\,c$ being, therefore, a side of the inscribed pentagon, and equal to the greater segment of $a\,o$ cut medially (Euclid, 4, 11, and Leslie's Rudiments, pages 60 and 80, &c.) Make an angle, $b\,o\,\iota$, at o, equal to $b\,a\,c$, and therefore half of $b\,o\,c$ (Euclid, 3, 17). Then $b\,e$ is a side of the regular decagon. It may easily be proved that $b\,e$ is equal to the greater segment of $o\,\iota$ when cut medially, for the triangle $o\,b\,e$ is in all respects similar to $a\,b\,c$; it is, therefore, an isosceles triangle, having either angle at the base double the vertical angle, and consequently, from the properties of such a triangle, $b\,e$ equal to the greater segment of $b\,o$, or of radius, cut medially.

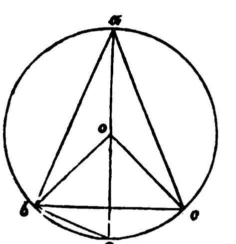


Fig. 3.

If the radius be 10 feet, it is cut medially, when $a^2 = 10 \times (10 - a)$ — where a denotes the greater segment (Euclid, 2, 11), in which equation $a = 6{\cdot}18$, &c., feet = the side of a decagon inscribed in a circle of 10 feet radius. But this is the chord of an arc of 36°; wherefore the sine of 18° = 3·09, &c., feet to 10 feet radius, or ·309, &c., to radius unity. So, also, it may be adapted to any other radius, as 20 or 100 feet.

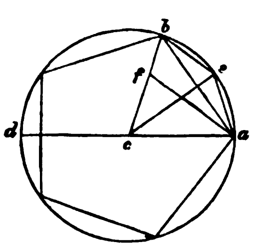


Fig. 4.

From the same circumstances may be obtained the side of the regular inscribed pentagon or chord of 72°. It may be proved that the square of the side of the inscribed pentagon is equal to the sum of the squares of the side of the decagon and of radius. Let $a\,b$ (fig. 4) be the side of a regular inscribed pentagon, in the circle $a\,b\,d$, and let $a\,\iota$ be the side of a decagon regularly inscribed in the same circle, and draw the lines shown in the figure, making $c\,f = \iota\,a$; the angle $\iota\,c\,d$ is double of $e\,a\,c$, since they subtend the same arc, the one at the centre and the other at the circumference (Euclid, 3, 17). But $\iota\,c\,d$ is double $a\,c\,b$, since it subtends $\frac{4}{10}$ths or $\frac{2}{5}$ths of the circumference, while $a\,c\,b$ subtends only $\frac{1}{5}$th; therefore, $\iota\,a\,c = a\,c\,b$ or $f\,c\,a$, and, consequently, the two triangles, $\iota\,a\,c$ and $a\,c\,f$, have two sides ($a\,c$ and $a\,\iota$) of one, respectively equal to two ($a\,c$ and $f\,c$) of the other, and the contained angles equal; wherefore, also, $a\,f = \iota\,c = a\,c$. But $a\,b^2 = a\,c^2 + c\,b\,.\,b\,f$ (Euclid, 2, 13), and it has just been proved that $c\,b\,.\,b\,f = c\,f^2 \;.\cdot.\; a\,b^2 = a\,c^2 + c\,f^2$ = the square of radius + the square of the side ($a\,\iota = c\,f$) of the regular decagon. Hence, as in the last case, if $r = 10$ feet, and a and b denote respectively the sides of the regular inscribed decagon and pentagon, $a = 6{\cdot}18$ feet, and $b = \sqrt{r^2 + a^2} = 11{\cdot}76$ feet, &c.

The student should practise these processes, also, for various radii, 11·76 = chord of 72° .·. 5·88, &c. = the sine of 36°, &c., from which its other lines may be determined, for $r = 10$ feet, or any other value.

The student should form a table of values for all these arcs, angles, &c., containing all the values of the several trigonometrical lines, calculated to radius *unity;* and he should recollect, or be able to refer to them, as they will be introduced into subsequent examples.

The following facts could be geometrically obtained also, and will enable us to arrive at the sines, &c., of some additional arcs. When radius is unity, the sides may be determined—of an equilateral triangle (= the chord of 120°); of the inscribed square (= the chord of 90°); of the pentagon (= the chord of 72°); of the hexagon (= the chord of 60°); of the heptagon = ·8677 (= the chord of 52° 25$\frac{5}{7}$'); of the octagon = ·7654 (= the chord of 45°); of the enneagon = ·6840 (= the chord of 40°); of the decagon = ·618 (= the chord of 36°); of the headecagon = ·5634 (= the chord of 32° 43$\frac{7}{11}$'); of the dodecagon = ·5176 (= the chord of 30°). In every one of these cases, all the trigonometrical lines may be found for any given radii, and for half the arcs named, the chord being double the sine of half the arc. Thus, in the case of the dodecagon, the sine of $\frac{30°}{2}$ (= 15°) = ·258, &c., when radius is unity, or 2·58 when $r = 10$, or 25·8 when $r = 100$, &c. &c.

Yet, though these and many other cases might be determined directly by geometrical relations, for all the trigonometrical lines, which may be found when one of them is known, still they afford no general principle on which they may be obtained for all values of the arc, and then tabulated for a given radius, and adapted to any other by the relations which we have already noticed.

To investigate some such general property as may serve this purpose, will form the subject of the next paper. It is known, that when the arc is very small, its sine and tangent do not differ in length from each other, and from it, by any appreciable quantity—they may be made to approximate to each other in value without limit, by continuing to subdivide the arc.

For all practical purposes, therefore, the sine may be taken as equal to the arc, when the arc is very small; and we have already seen how the length of a very small arc may be found—as one-millionth of a second—which is a certain part of the circumference, which we know how to find when radius is known.

Knowing the sine for one arc, we can find it for two, for three, &c., by knowing the laws which connect the sines of such arcs together. This we next proceed to investigate.

MESSRS. FAIRBAIRN'S TANK LOCOMOTIVE.

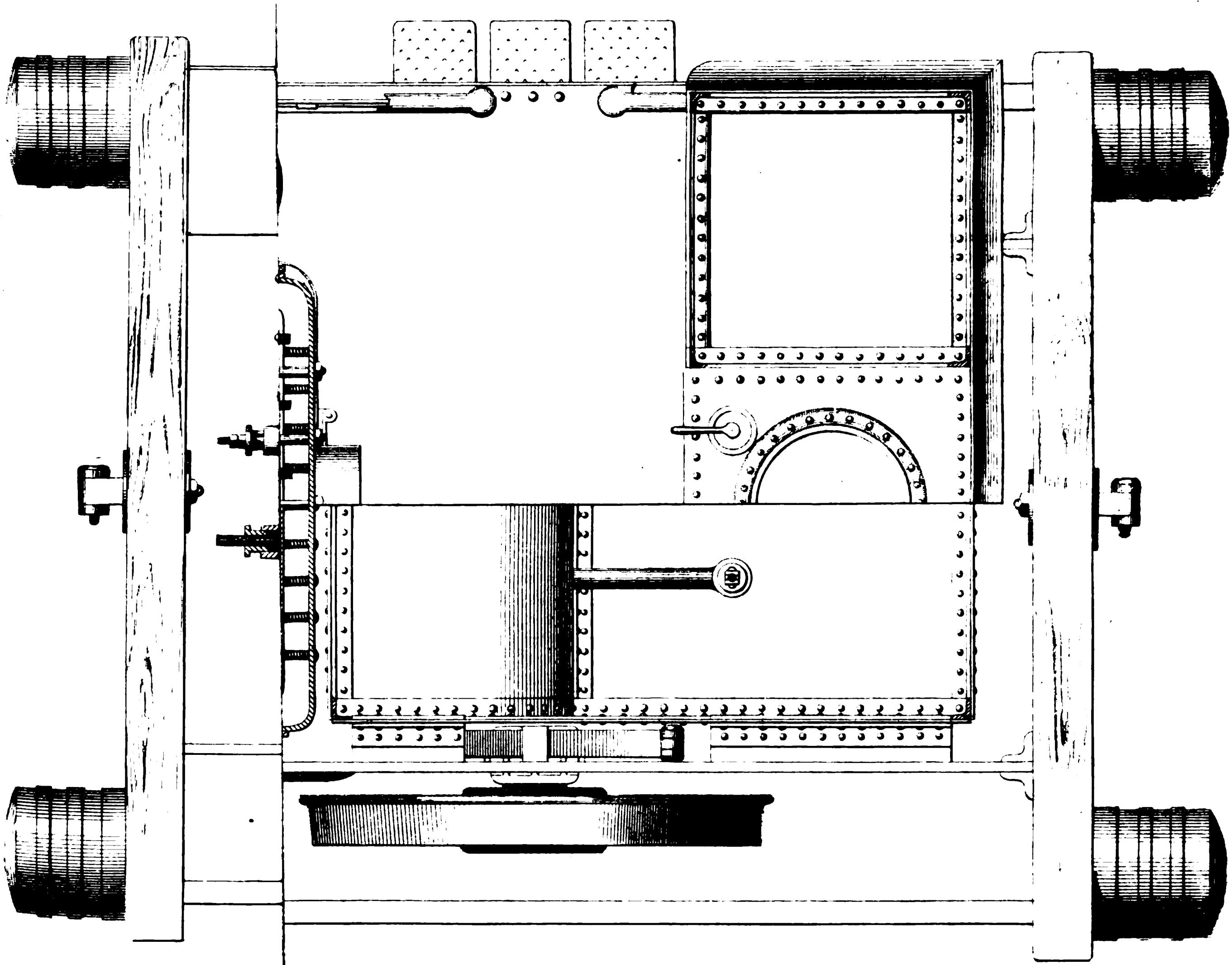
(Illustrated by Plates 89 *and* 91.*)*

Day by day, and each day, the travel of Great Britain's locomotive engines amounts to some four-and-a-half times the circumference of the globe. In 1850, the number of engines amounted to near 2,500, the quantity of coke consumed by them being 628,000 tons. The total distance run within the year was 40,161,850 miles, giving an average daily journey of 110,333 miles—6,464 miles of line being then under traffic. So powerful an agent in the pursuits of human life might then well attract attention to the examples of its class, in the Great Exhibition, where it was to be expected that the best fruits of modern practice would be displayed. From this collection we have now presented our readers with the works of two eminent makers, Messrs. Hawthorn of Newcastle, and Messrs. Fairbairn of Manchester,—the first being a six-wheeled inside cylinder engine, of the ordinary class; whilst the second, of which we now give an additional plate, is of the large six-wheeled "tank" kind.

Plate 89 is a longitudinal section of Messrs. Fairbairn's engine; and Plate 91, accompanying the present paper, is a plan or horizontal section, with one half of the boiler and upper works removed to lay bare the working gear beneath.

Plate 91

Vol. IV.



10 Feet.

W. Johnson, Patent Offices, London, Glasgow & Edinburgh.

J Scott Sc Glasgow.

Fig. 1.

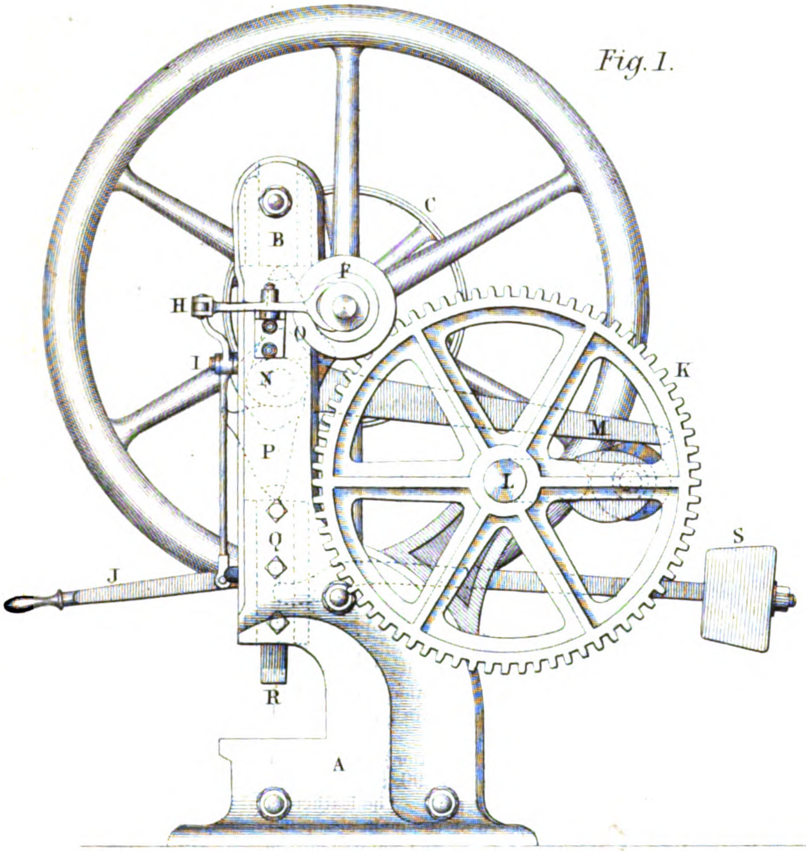
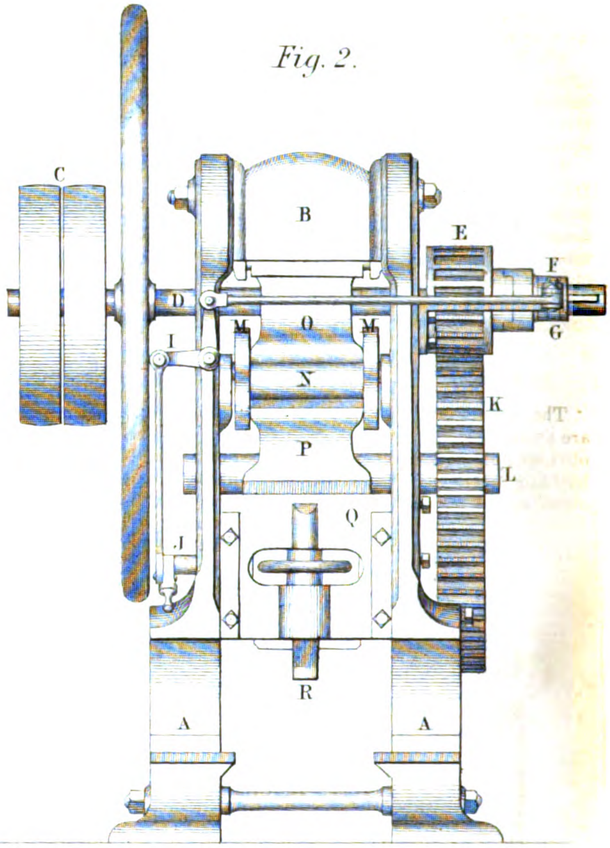


Fig. 2.



Scale

Ins. 12 9 6 3 0 1 2 3 4 5 Feet

Fig. 3.

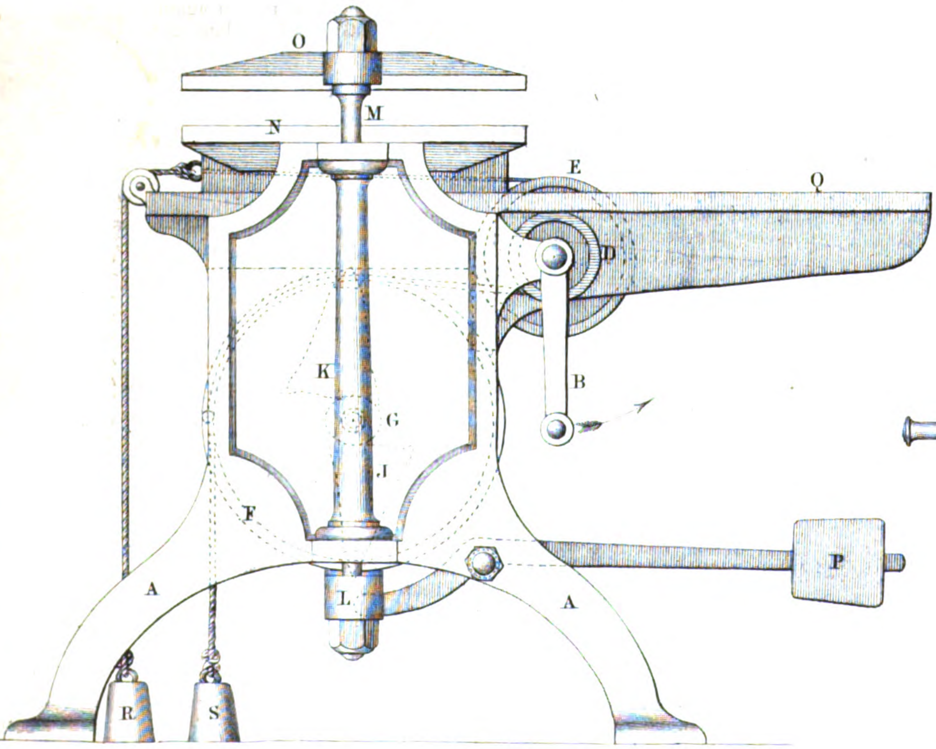
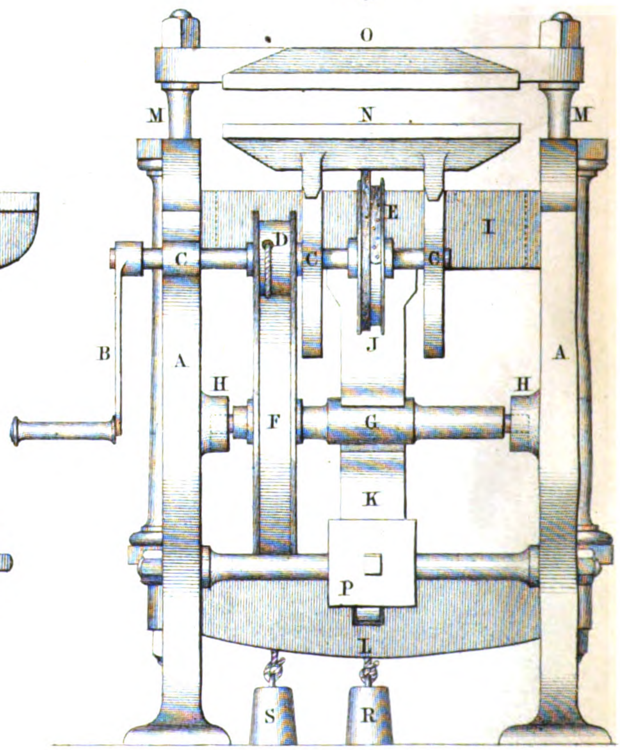


Fig. 4.



These views are clear enough to render much detail unnecessary; but we may append the chief dimensions:—

The boiler is 3 feet in diameter, and 8 feet long, containing 88 brass tubes, 2 inches external diameter. Outside fire-box, 3 feet by 3 feet 6½ inches; depth, 7 feet 2 inches. Inside copper-box, 2 feet 5 inches by 3 feet; depth, 3 feet 5 inches. Total effective heating surface, 480 square feet.

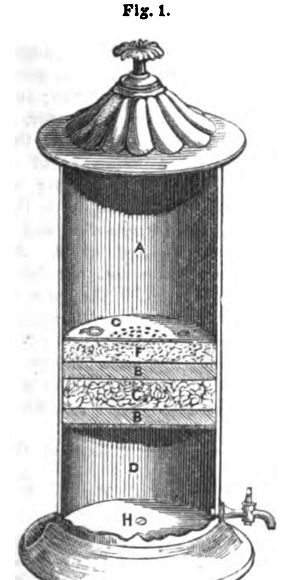
The cylinders are only 10 inches diameter, with a stroke of 15 inches. Driving wheels, 5 feet diameter; leading and trailing wheels, 3 feet 6 inches. The water-tank has a capacity of 400 gallons. Ascertained consumption of coke, 10 lbs. per mile. Weight, in working trim, 13 tons. As to power, the makers state it to be equal to the conveyance of six composite carriages, holding 250 passengers.

The engine is well balanced on its wheels, and is a fair specimen of the heavier class of tank, or combined engine and tender locomotives.

RANSOME & PARSONS' FACTITIOUS STONE FILTERS.

The patent stone works of Messrs. Ransome & Parsons at Ipswich, are amongst the lions of the county of Suffolk. In addition to the many obvious applications of this very beautiful factitious material in the building and decorative arts, it has found a most important use in the manufacture of water filters. Our engraving, fig. 1, represents a vertical section of a "purifier, or universal filter," fitted with two layers of the stone. It forms a rather handsome pillar. The space, A, in the upper part, is that occupied by the unfiltered water. The two artificial stone discs are at B, B, the space, C, between the discs being occupied by a mass of a chemical disinfectant, through which, and through the two stone layers, the fluid must pass before it can reach the pure water chamber, D, at the base, whence it may be drawn off by the discharge cock, E. To cover the upper filtering disc, and prevent its choking by slimy deposits, a layer of fine sharp sand, F, is laid over all, and shielded by a perforated cover, G, removable at pleasure for cleansing. A screw, H, is fitted to the bottom to facilitate the operation of cleansing. The water, by first passing through the layer of sand, and the porous stone discs, is deprived of any remaining matters which may be held in suspension, whilst the chemical disinfectant abstracts whatever deleterious element may be left in solution.

Fig. 1.



The porous stone is variously applied in other modifications of filters. For instance, when intended for high pressure filtering, a hollow cylinder of the stone is fitted inside a correspondingly shaped external case, an annular space being left between the two all round. The water is supplied to this annular space, and has thus the whole external area of the inner stone cylinder as a filtering surface, through which it finds its way into the interior, whence it is drawn off as required.

Fig. 2.

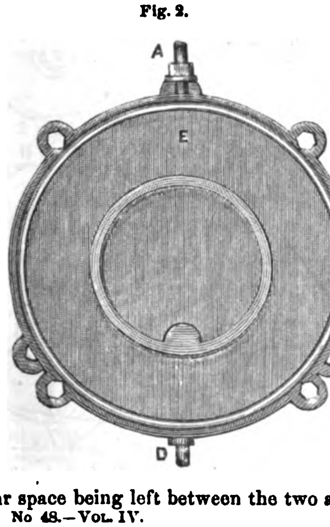


Fig. 3.

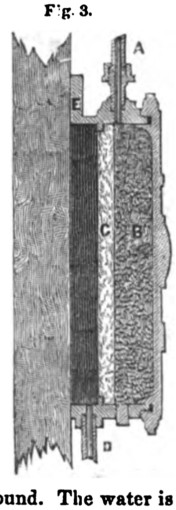


Fig. 2 is a front external elevation of a "disc filter," intended as a wall fixture. Fig. 3 is a vertical transverse section of the same. This is a very neat and effective form of filter; in shape, a shallow cylinder, with an ornamental lid bolted upon it. The inlet, or unfiltered fluid supply pipe, is at A, on the upper side of the filter, where it opens into the cylinder amongst the particles of a layer of a chemical disinfectant, B. After percolating through this medium, the chemically purified water passes through the stone disc, C, thence flowing off by the discharge pipe, D, at the lower side. The lid, E, which holds down the chemical layer, is secured to its cylinder by four bolts, to admit of an easy adjustment of the filtering media when necessary.

THE ROLLING INCLINE MOVEMENT.

(Illustrated by Plates 90 and 92.)

The Americans have beaten us in yachts and centrifugal pumps, and we are now compelled to admit that they have triumphed over us in presses. The "rolling incline," originally invented by Mr. Dick, but since greatly modified, improved, and extended in its applications by Mr. Gwynne, was decidedly the best example of this species of mechanism which could be found in the Exhibition.

The advantages which this invention possesses over all existing power-gaining contrivances, are the almost entire annihilation of friction—simplicity of parts—and quickness of effect. The principle is capable of modification to suit all possible purposes, for which the screw, lever, and hydrostatic machines are now employed; whilst it may be adjusted to produce rapidity of motion at one part of the stroke, and a slow, powerful action at another. In it the line of force is always directly coincident with the line of motion; and it has the important feature, that it will maintain its pressure for any length of time, there being no back or negative action.

We have already furnished illustrations of three distinct working arrangements of this invention in plate 90, to which reference has been made at page 249 of our February part. The leather-embossing press, fig. 1, on that plate, is composed of the main side pillars, A, connected at the top by a stout cross-beam, B, and supported beneath upon the heavy base, C. The actuating cam or oval roller is at D, its spindle being carried in end bearings, E, cast on the sides of the pillars. It is worked by the hand-lever, F. The lower concentric sector, G, rests by its angular edge upon the surface of the base plate, and upon its curved surface the roller or cam, D, rests. On the opposite side of the roller is placed the long inverted concentric sector, H, resting by its lower curved end upon the roller, its upper end being angular or knife-edged, to bear against the under side of the sliding beam, carrying the pressing plate, I, to which beam it is also hinged by small bearing-caps, so that it cannot fall away out of position. Then, on the cam, D, being turned partially round by the lever, F, it is clear that the pressing plate, I, sliding vertically between the pillars, will approach to, or recede from, the corresponding plate, J, of the fixed beam, B, accordingly as the lever is turned back or forward by the rolling of the cam, D, between the curved surfaces of the two sectors, the end bearings of the cam-shaft having liberty to rise and fall to the extent required—in slots in the pieces, E. Instead of having the eccentricity upon the roller, D, it may be confined to the sectors, provision being made for the vertical travel of the spindle in its end bearings; or both sectors may be made eccentric, to work either with a plain roller or a cam. In its general features, the press resembles, as we have before stated, an ordinary packing-press; but it is in reality arranged as an embossing machine for leather, for which purpose a short traverse only is required. The leather is laid on the table, I, and the impression is given by a die carried on the platten, J, fixed overhead. In the hand-punch or embossing press, fig. 2, the same arrangement of concentric sectors, with a duplex eccentric roller or cam, is used. A is the main frame, somewhat like that of an ordinary slotting machine, the front edges or double face—for it is formed with two branches, to admit the cam and lower sector to work between—being cast with upper and lower bearings, B and C. The eccentric or cam, D, is duplex, or of an oval section, and it is worked by a hand-lever as in fig. 1. At E are two parallel guides, connected overhead by a cross piece, F, against the under side of which the acute angle or bearing centre of the upper sector, G, abuts, whilst its curvilinear face rests on the cam. The lower corresponding sector, H, is set in precisely the same position on the opposite side of the cam, its lower angular end resting on a sliding cross-head, I. The spindle of the cam, D, has also, in this instance, liberty to rise or fall a short distance in its two bearings in the branches of the standard. As delineated in our drawing, the punch is supposed to be elevated to its

full extent in readiness for a stroke, the shortest diameter of the cam being interposed between the two sectors. But if the inclined hand-lever, extending out behind the machine, is brought down to a horizontal position, or still lower, then the acting diameter of the cam is by so much increased, and the slider, I, descends upon its guide-rods, carrying with it the punch or embosser. The lower weighted lever, working on a fixed stud in the side of the standard, elevates the whole of the descending apparatus after each stroke.

Fig. 3 is a front elevation of the "rolling incline" pile or stump-drawing machine; and fig. 4 is a corresponding vertical section. A, A, are the main cast-iron side standards, bolted down to a metal base plate, and arranged to carry the bearings for the working mechanism, which is actuated by the winch-handles, B. These handles are fast on opposite ends of the first motion-driving spindle, carrying a pair of toothed pinions, C, just outside the standards, and working in bearings in projecting arms, D, cast on the standards. These pinions gear respectively with the spur-wheels, E, fast on the shaft of the main roller or cylinder, F. This shaft works in bearings capable of sliding vertically in slots in the standards, and its actuating roller portion in the centre is turned down to a slightly less diameter than the remaining length, in order to form a guide groove or annular recess for the cams or "rolling inclines," G, H. These are keyed on the central portions of the upper and lower spindles, I and J, which have liberty to rise and fall in vertical grooves in the side standards, whilst they work in contact with the peripheries of the concentric sectors, K, L. There are two pairs of these sectors, set parallel to each other, so as to bear upon the spindles, I, J, at equal distances on each side the rolling inclines. This is clearly delineated in fig. 3: the centres or working edges of the upper pair, K, bear against the lower side of the stout cross-beam, N, whilst the lower pair, L, work in like manner on the bar or base-beam, M, beneath. In the engraving, fig. 4, the "stump-drawer" is represented at the bottom of a lift, or at zero, the main roller, F, fitting to the quick curves on the peripheries of the rolling inclines at the point where the top and bottom of the inclines, or the greater and lesser radii, are brought into connection. Then, as the roller is turned by the action of the winch-handles, its frictional contact with the cams causes the latter to revolve also, until, at the termination of the action, the greater radii are in contact with the roller; or, in other terms, the cams may be said to have rolled along the periphery of the roller, F, until the latter is in the position of having ascended to the summit of the inclines of the cams. At the same time the spindles, I, J, have rolled along the sectors, K, L, until they have respectively reached the opposite ends of the concentric curves. It is then obvious that the centres, I, J, of the two rolling inclines must have been sundered by this action to the amount due—or equal to, their combined eccentricities or inclines; and as the base, M, is a fixture, the consequent motion must be entirely upward. The upper portions of the standards, A, are forked, or slotted out to a considerable extent, to receive and guide the heavy cross-beam, N, to which the upward traverse movement is thus communicated. Guides are fitted on the top of the beam, N, to receive a short horizontal spindle, O, fitted with a pair of helical springs, which act upon sliding catches or detents, tending to cause them to gear constantly with the inverted teeth of the two vertical racks, P. These racks are connected at the bottom by a cross piece, Q, forming a means of attaching the traverse apparatus to the stump or pile to be extracted.

In commencing to lift, the parts of the machine stand in the position shown in our view, and the two handles, B, being turned by the attendant labourer, the beam, N, is gradually elevated, as already explained, to the height of the given traverse of the two rolling inclines, and the detents of the springs, O, being in gear with the racks, P, they, with the bottom piece, Q, are elevated at the same time. When the summit has been attained, a pair of sliding detents on the base, kept constantly pressed into gear with the rack-teeth, by blade-springs fast on the standards, now come into action, and sustain the lift, whilst the upper detents slide down, over the inclined teeth, on the gearing being reversed for a second lift. In this way a succession of short powerful lifts enables the engineer or the back-woodsman to secure any required length of action.

In plate 92 are two other examples of familiar mechanism, to which the new power is applied. Fig. 1 is a side elevation of a "railway bar straightener," or bender; and fig. 2 is a corresponding front view. The massive standards, A, carry the entire apparatus. They are held together transversely by tie-rods, and have a powerful cross-beam, B, between their upper ends. The machine is actuated by the fast and loose pulleys, C, on one end of the shaft, D, which carries a fly-wheel to steady its motion. The opposite end of this shaft has upon it a pinion, E, which may be connected or disconnected from the shaft at pleasure, by the sliding clutch, F. This clutch is worked by a forked lever, G, set on a fixed stud attached to the standard, and connected at H with a link passing to the bell-crank, I, on the opposite side of the machine, where the attendant is posted, to work the disengaging lever, J.

The pinion, E, gears with the large spur-wheel, K, fast on one end of the crank-shaft, L, the crank of which has formed upon it a stout projection, as a bearing for a loose anti-friction pulley, on which the free ends of the pair of actuating levers, M, are made to bear; then, as the shaft, L, constantly revolves, the levers, M, which are fast on the cam spindle, on each side of the double cam, N, have a reciprocating traverse communicated to them, each time the crank makes a revolution. The spindle of the cam, N, has, of course, the power of sliding vertically, to a small extent, in the inner sides of the standards; and the beam, B, being a fixture, the eccentric traverse action of the cam, between the two sectors, O, P, gives to the slide, Q, on which the angular edge of the lower sector acts, a vertical movement.

The rail to be operated upon is laid across the two bearers, near the bases of the standards, and the downward pressure of the stud, R, which is fitted with a vertical screw adjustment, gives the necessary straightening or bending action. The balance weight, S, on the end of a lever, working on a fixed stud in the frame, brings up the whole of the moving parts after each stroke.

Fig. 3 is a side, and fig. 4 a front view of a "rolling incline" printing press. The standards, A, carry the entire press, making it portable. It is worked by the single winch-handle, B, the spindle of which is supported in the three bearings, C, and carries a small cord pulley, D, and a larger band pulley, E. A cord attached to, and wound upon the pulley, D, passes round, and is attached to the large pulley, F, fast near one end of the spindle of the double cam, G. This spindle, as in the former arrangements, is carried in end sliding bearings, H, in the standards. The cross piece, I, at the top, answers for the fixed abutment for the pressure; and against the lower side of this, the angular edge of the upper sector, J, is made to bear, whilst the lower one, K, similarly works against the upper side of the lower moveable beam, L. The latter is connected at each end to the lower ends of the pair of vertical rods, M, passing up through recesses in the standards, and attached above the table, N, to the platten, O. The table is supported in the usual way in V grooves, and is brought in and out at each printing action by the band pulley, E. As the handle, B, is turned in the direction of the arrow when the table is run in, as shown in fig. 3, the consequent revolution of the cam, G, brings down the platten, and gives the impression; and when the handle is reversed, the weighted lever, P, elevates the platten, whilst the revolution of the pulley, E, draws out the form of type upon the bearers, Q, to be inked. The return of the form is effected by the weight, R; and the weight, S, acts similarly in bringing round the main pulley, H, when its actuating cord is slackened.

In the three following diagrams, we have illustrated some of the

Fig. 1.

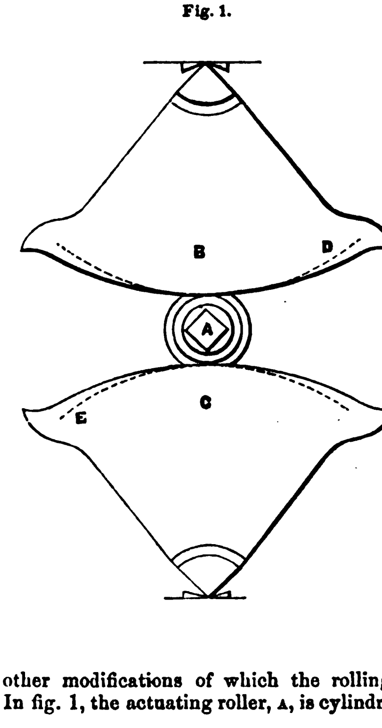
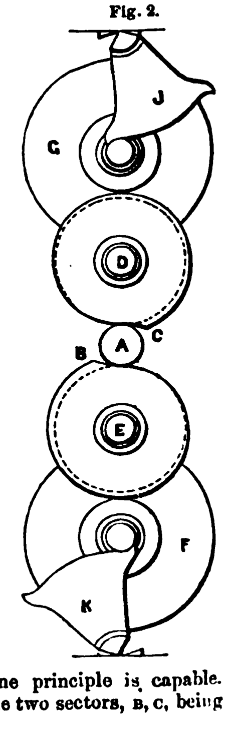


Fig. 2.



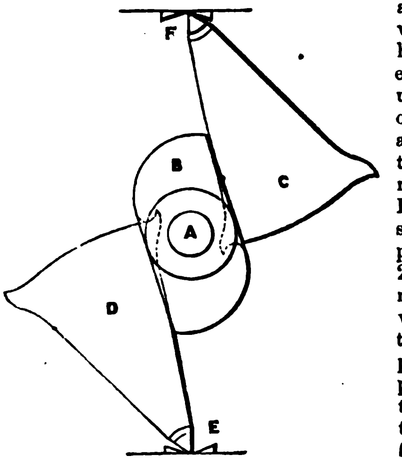
other modifications of which the rolling incline principle is capable. In fig. 1, the actuating roller, A, is cylindrical, the two sectors, B, C, being

themselves eccentric, their curved acting surfaces being formed to a curve of larger radius than the working centres, as indicated by the dotted curves, D, E, which are the real concentric lines. By this arrangement a duplex action is produced; that is, the eccentricity being, as it were, on each side the centre of action, two similar traverse movements are obtainable without reversing the motion of the roller.

Fig. 2 is a diagram of an extension of the principle adopted in figs. 3 and 4, on plate 90. The roller, A, is here also cylindrical, and actuates the two volute cams or rolling inclines, B, C, the eccentricity of which is shown by the inner concentric dotted lines. The axes, D, E, of these cams work in contact with the peripheries of the concentric anti-friction discs, F, G; and as the latter are thus made to revolve, their axes in turn work over the curved faces of the sectors, J, K. It is obvious that the use of the two discs, F, G, affords a very considerable increase of power, without affecting the length of the stroke.

Fig. 3 is the least powerful of all the arrangements which we have illustrated; but it is correspondingly quicker in action and longer in stroke. The driving shaft, A, carries the duplex cam, B, with opposite curved ends—its two opposite sides being recessed, to admit the entrance of the ears of the pair of sectors, C, D. At E, F, are the usual bearing edges of the sectors. This modification has been proposed for cheese presses, as it affords a long stroke, and gives the most powerful compression near the termination, when the curves begin to bear on the sectors. Mr. Gwynne has applied the "rolling incline" to no fewer than 120 different uses. As a lifting jack, he has constructed it to lift six tons, whilst it occupies only one foot six inches in height, with a diameter of six inches, and weighing scarcely half a hundred weight. In small works, such as counting-house copying-presses and embossers, it is particularly useful; whilst in larger ones, the inventor can show a press of greater power than the celebrated hydrostatic machine of the Britannia Bridge. We were recently shown punchings of inch-plate iron, and cuttings of 2 by 1 inch, made by the machine in cold metal, and without any fly-wheel, by two men—the great *initial* pressure having a most important effect in carrying the punch through the metal. An eminent London firm, employing the press to emboss book covers, state that they are now able, by its assistance, to reduce four hours' work within the compass of one.

Fig. 3.



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RECENT PATENTS.

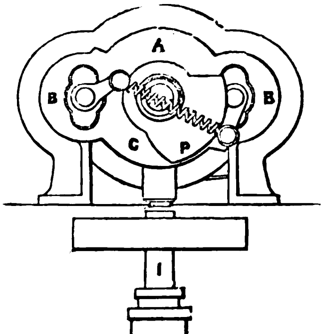
THE "MOSKOVKA" ROTATORY ENGINE.

GAETAN KOSSOVITCH, *London.—Enrolled November* 3, 1851.

This engine is the invention of Mr. Alexis Khomiakoff, of Moscow, for whom it has been patented in this country by Mr. Kossovitch, a resident in London. From the copiously illustrated descriptive pamphlet which Mr. Kossovitch has put into our hands, we gather that "the novelty of the 'Moskovka' consists in the constancy of the steam current, and of the vacuum produced by its mechanism"—this constancy being obtained by the introduction of steam, and its escape taking place through moveable parts revolving with the piston and axle.

Fig. 1 is an external end elevation of the engine removed from its supporting standard. Fig. 2 is a plan corresponding; and fig. 3 is a transverse vertical section through the cylinders. The main body of the engine is composed of a fixed cylinder, A, opening on both sides into two semi-cylinders, B, B, and by its bases, into the two minor cylinders, C, one of which latter communicates with the steam boiler by the inlet pipe, D, and the other with the condenser by the outlet pipe, E. The central cylinder is occupied by a revolving cylinder, G, fitted with a projecting piston, H, and carried on the rotating shaft, I. The revolving hollow cylinder, G, has a central division-plate, cutting off all direct communication between the outlet and inlet sides, and serving to connect it to its shaft. It has two openings at J, K, one on each side the division-plate, and before and behind the revolving piston, one being the inlet and the other the outlet for the steam. The two semi-cylinders contain two "shutters," L, M, capable of turning on the spindles, N, O. These shutters work alternately, L being represented as open to allow the revolving piston to pass it, whilst M is closed, one of its sides bearing against the revolving cylinder. These shutters are actuated by the external revolving eccentric, P, the connecting helical spring passing across from lever to lever of the spindles, effecting the return movement.

Fig. 1.



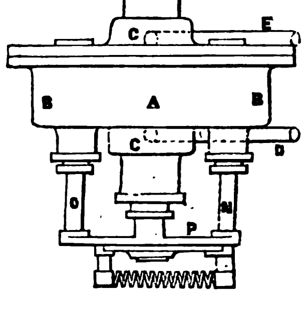
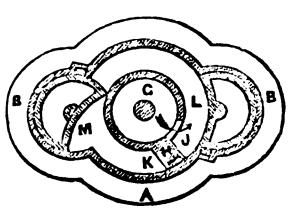


Fig. 2.

The steam, entering by the pipe, D, finds its way through the small cylinder, C, into the upper half of the revolving cylinder, G, and thence through the aperture, J, as indicated by the arrow, into the large outer cylinder, A, where it acts upon the piston, H, to urge round the main shaft, whilst the shutter, M, forms the necessary opposing abutment. As the motion goes on, the other shutter, L, being released from the pressure of the eccentric, turns back (by the effect of a counterpoise, or of steam pressure), and one of its edges then presses on the cylinder, G, the shutter, M, being similarly opened, to allow the piston to pass, the steam escaping through the opening, K, in the lower half of the revolving cylinder, and thence to the condenser.

Fig. 3.



The shutter action is ingenious, and will probably work smoothly and noiselessly. The inventor shows various modifications of his plans; but the form we have shown will be sufficient to indicate the nature of this—the first Russian invention which has appeared in the pages of the *Practical Mechanic's Journal.*

SUGAR MILLS.

J. B. MIRRLEES, *Engineer, Glasgow.—Enrolled February* 7, 1852.

Mr. Mirrlees proposes three essential features of improvement in sugar mills. First, an arrangement wherein the steam-engine or actuating power is combined with the mill in such a way that the same framing shall answer both for engine and mill, and thus add stability and firmness to the whole machine. Second, the heating of the expressed cane juice, by passing waste steam through a chamber in the base plate, over which the juice flows as it leaves the rollers. Third, the constructing of sugar mills with framing of malleable iron.

The patentee gives several views of one form of mill with cast-iron framing. The actuating steam cylinder is placed vertically, and is bolted to the side of the base plate, from which spring two main standards. The lower portions of those standards serve to retain the bearings

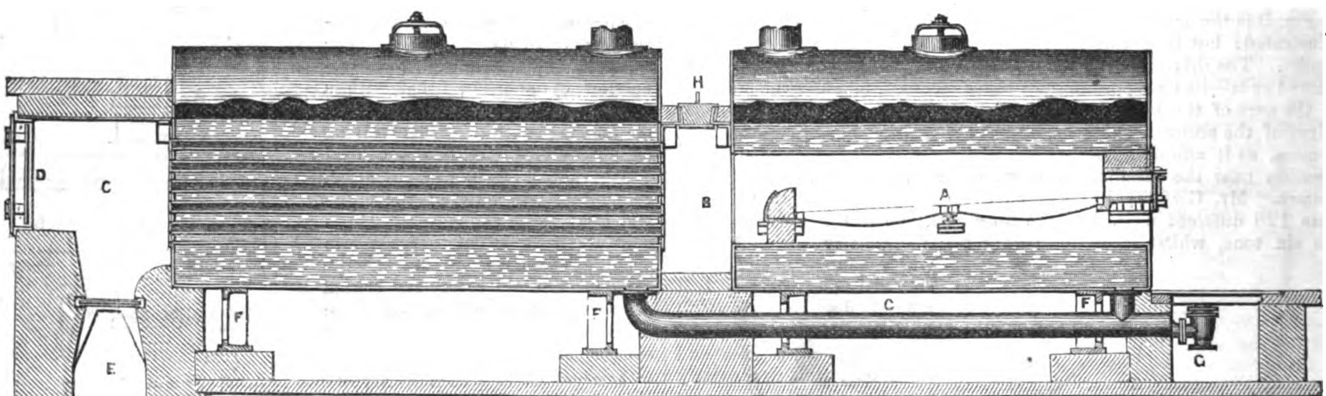
of the three crushing rollers, whilst their upper ends carry plummer blocks for the overhead crank-shaft, which carries a pinion in gear with a large spur-wheel keyed on the shaft of the central crushing roller. This arrangement simplifies the details of the mill, and permits of the standards themselves being used as supports for elevating and adjusting the rollers and heavy component parts without the use of triangles or other supports. The framing of the mill being also the framing of the engine and gearing, the combined arrangement is less liable to derangement from strains, or the subsidence of the building or foundations, than existing plans.

We shall shortly be enabled to enter into the details of the mill, in connection with an illustrative plate.

STEAM-BOILERS.

John Hick, *Bolton-le-Moors.—Enrolled January* 17, 1852

Fig. 1.



This invention consists in the combination of a Cornish double-flue boiler, with an ordinary multitubular one, the two being set end to end, with an intermediate gas chamber connecting them. Fig. 1 is a longitudinal section through both boilers and their appurtenances. Fig. 2 is an end elevation of the flue boiler; and fig. 3 is a transverse section through the gas chamber.

Only one boiler, the Cornish one, is fired, the furnaces, A, being arranged to discharge the products of combustion directly into the intermediate brick chamber, B, the two ends of which are formed by the two ends of the boilers. The object of this is to effect a more perfect combustion of the gaseous products prior to passing them through the tubes of the second boiler, or what is, practically speaking, the second half of

Fig. 2.

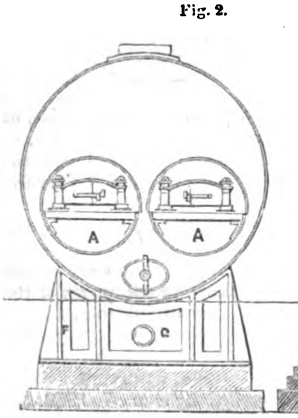
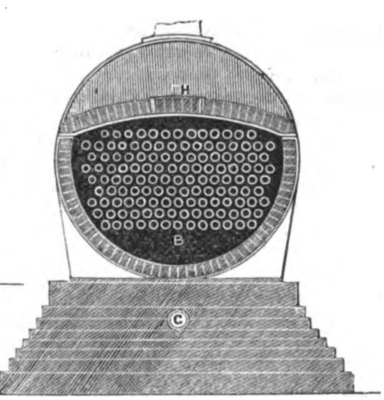


Fig. 3.

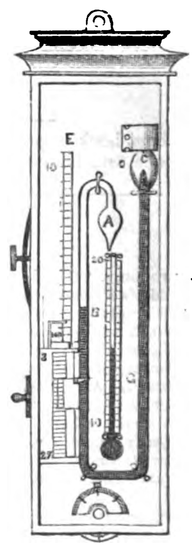


a single boiler. After passing through the tubes, the current enters the end flue, C, which is fitted with doors, D, for cleaning out, and thence descends into the bottom main flue, E. The two lengths of the boiler are carried on cast-iron bearers, F. G is the water connecting pipe and blow-off cock. The two divisions have their steam portions in connection by means of vertical pipes, surmounted by domes, and connected above the intermediate chamber by a cross pipe, each dome having its separate safety-valve. Provision is made for access to the gas chamber by an overhead door at H. The boiler tubes are of wrought-iron, 3 inches outside diameter. The gas chamber being lined with fire-bricks, as an effectual non-conducting medium for heat, a much higher temperature is secured at that part than at any other, and thus the gases are effectually ignited as they pass through.

COMPENSATING PORTABLE BAROMETER.

A. O. Harris, *London.—Enrolled August* 26, 1851.

Mr. Harris, the well-known philosophical instrument maker, of High Holborn, has brought forward his "compensating portable" instrument as being "more sensitive and less liable to derangement than any other;" and he has certainly succeeded in considerably improving upon the common barometer. Our engraving represents a front view of the barometer in the form intended for the house. It is 12 inches in length, 3 in breadth, and 1¼ in thickness. The reservoir, A, with the tube, A to B, is filled with gas, and the remainder of the tube, from B to C, with the reservoir, D, with mercury. At the top of the reservoir, D, is a contrivance for the free admission of the atmosphere, without the possibility of the mercury escaping upon the instrument being reversed, or even violently shaken. The scale from E to F is a measure for the expansion and contraction of the gas from heat and cold, and is termed the compensation scale, for by it, with reference to the thermometer, G, an allowance is made for that expansion and contraction, and the pressure of the atmosphere correctly obtained in the manner following:—The scale of inches below F G corresponds with the scale of inches on the ordinary barometer. This scale moves up and down upon the face of the compensation scale, and at the upper end of it is a pointer or index, which moves with the scale, and can be directed to any division of the compensation scale. To ascertain the weight of the atmosphere, the index is directed to the division on the compensation scale corresponding to the degree of temperature indicated by the thermometer at the moment, and that division on the barometer scale, in a line with the mercury, is the measure of the weight of the atmosphere. At the bottom of the plate of the barometer is a circular plate, moving on a centre, and divided into inches and tenths, corresponding to the barometer scale, the use of which is to register the height of the mercury at any particular time. The vernier attached to the barometer scale is constructed to be read off to one-hundredth of an inch.



STEAM-ENGINES.

James Whitelaw, *Johnstone.—Enrolled January* 31, 1852.

These very important improvements in steam machinery, relate,—

1st. To the construction and arrangement of engines for the purpose of securing the principal advantages of a long-stroked engine with a short stroke of the piston—the object being to embrace the chief points of excellence of both kinds of engine, without at the same time entailing the disadvantages of either class.

2d. An arrangement for securing greater uniformity of speed to the crank-shaft of steam-engines working to a high degree of expansion, by so proportioning the weight of certain of the moving parts of the engine, that their inertia may tend to equalize the action of the variable steam pressure in the cylinder.

3d. Securing increased nicety of adjustment of the rate of steam-engines, by the application of "a secondary action" to the governor.

4th. An arrangement for balancing the steam pressure on the backs of slide valves by a fluid counter-pressure beneath the faces.

5th. An improved form of buckets or lifting pistons for air-pumps, as well as for valves of various kinds.

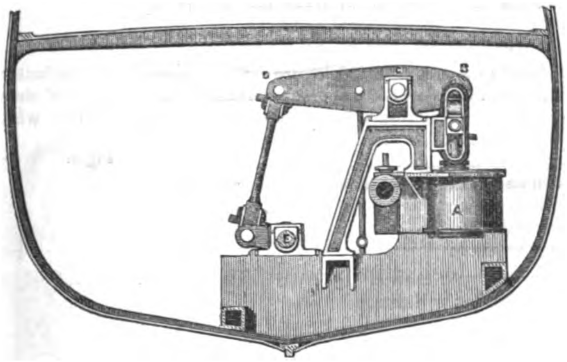
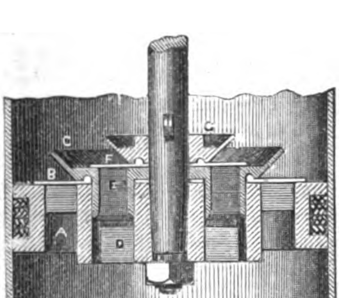


Fig. 1.

We shall meanwhile select the first and last heads for our illustrative description. To exemplify his first improvement, the patentee gives a transverse section of the "City of Glasgow" screw steamer, showing her overhead beam engines actuating the screw-shaft by means of a wheel and pinion, the beams having equal lengths on each side of the main centre. Fig. 1 of the engravings represents a section of the same vessel as fitted with the "differential beam" engines. The cylinder, A, is placed on one side of the vessel, and the piston-rod is connected by links to the end, B, of the working beam, which, in place of being set to work on a centre equidistant from each end of the beam, as in the "City of Glasgow's" engines, is carried on the centre, C, placed considerably nearer to the centre line of the cylinder, than to the connecting-rod centre. In the case before us, the distance from B to C, the respective centres of the piston-rod connection, and the main centre of the beam, is one half the length from C to D, the main centre and the connecting-rod centre. In this way the engine has a short stroke, and therefore admits of being driven at such correspondingly high speed as may be required to drive the shaft, E, of the screw-propeller direct, at the same time that the reduced pressure on the crank, and its increased length, give to the engine most of the advantages of one of the ordinary kind, having a length of stroke even greater than that corresponding to the length of crank in the improved engine. The engine is besides cheaper, lighter, and occupies less room than the common kind.

Fig. 2.



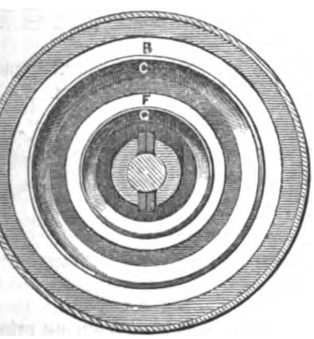


Fig. 3.

Fig. 2 is a vertical section of Mr. Whitelaw's improved air-pump bucket, and fig. 3 is a complete plan. It is packed in the usual way, and has, first of all, a large exterior annular water-way through it, as at A, strengthened and connected to the inner portion by radial web-pieces. This water-way is covered by a flexible ring, or annular valve, B, forming the lower story, or lift. This valve is secured down on its seat by the binding pressure of the second story piece, C, which acts as a guard to keep the valve from rising too high, whilst it has also a cylindrical collar fitting into the upper portion of the second story annular water-way, D. This collar has also an annular thoroughfare, E, corresponding with the water-way beneath it, and this is covered by the elastic annular valve, F, held down by the upper guard, G. This guard is kept in position by a cutter passed transversely through the bucket-rod, and thus binds both valves and guards securely down. Such a bucket will act much quicker than the ordinary kind, and with far less concussion, whilst it affords a clear water-way, and brings the rising fluid towards the centre of the pump.

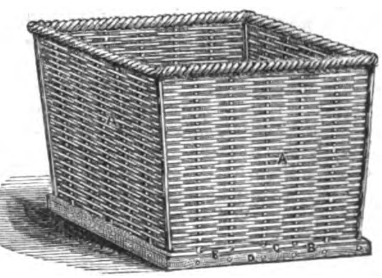
We shall hereafter enter more fully into the details of this specification, which contains much that is practically valuable.

REGISTERED DESIGNS.

WICKER-WORK SKIP, WITH WOODEN BOTTOM.

Registered for Mr. James Emery, *Preston.*

The "skip" is a technicality of the Lancashire and Cheshire cotton manufacturers. It is a rectangular wicker-work basket, employed in great quantities in cotton mills for the reception and conveyance of "cops" and yarn, during the elaborate process of transforming the raw cotton into the material fabric for shirts and dresses. Our sketch represents Mr. Emery's design in perspective. In place of the uprights or supports of the wicker-work, A, being brought into the centre of the bottom of the basket, as in the ordinary system of construction, they are each inserted vertically into holes, B, formed along all the edges of a wooden bottom, C. A band or hoop of iron, D, is secured round the edge of the wooden bottom by pins which pass through the lower extremities of the supports, thus effectually securing them in their places, and protecting the wooden bottom from injury. This system of "build" obviously adds stability and durability to the wicker structure.



KUKLOSIPHON OR FETLOCK BOOT.

Registered for Mr. S. Webb, 118 *Oxford Street, London.*

This is a simple contrivance intended to be worn by horses, for the purpose of preventing their cutting their legs by knocking their feet against them. It is nothing more than a short conical vulcanized india-rubber sock or band, round the wider and lower end of which is formed a hollow ring of the same material. This is drawn over the hoof, its elasticity enabling it to retain any desired position, whilst the elastic ring forms an effectual shield or buffer, to receive any chance side blows.

WHEAT-CLEANING MACHINE.

Registered for Mr. T. W. Stephens, *St. James' Street, Dublin.*

The introduction of French and American flour into this country has induced an amount of competition which demands vigorous exertions on the part of British millers, to enable them to keep their ground. It is, besides, undeniable that the superiority of the French flour is due as well to the care bestowed on the cleaning and dressing processes, as to the superiority of climate so much insisted on. The French are careful millers: the English, generally speaking, are not; and they owe a large amount of their shortcomings to their defective cleansing apparatus. If

the wheat is not well cleaned, the flour made from it must be inferior, irrespective of all subsequent attention in dressing. In the horizontal

Fig. 1.

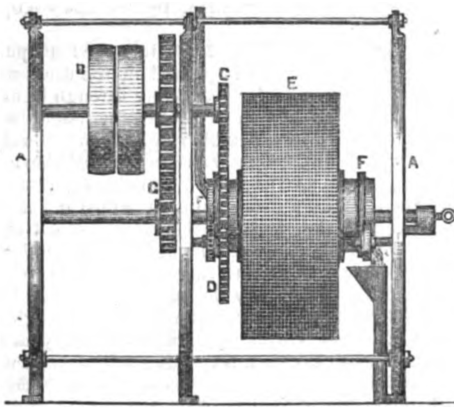
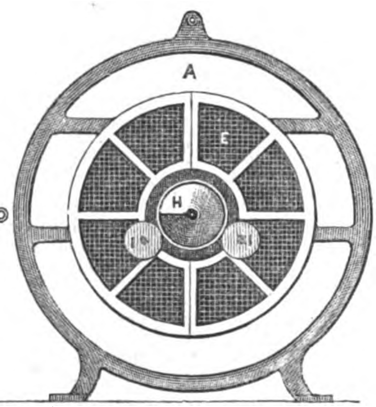


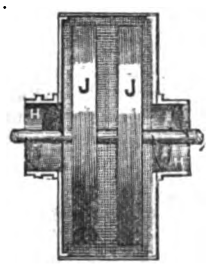
Fig. 2.



millstones usually employed, the large grains are cut too much, whilst the smaller ones escape untouched. Again, rough sheet-iron loses its asperities with wear.

Mr. Stephens proposes the use of flint stones as superior to both plans. Fig. 1 of our engravings is a front elevation of his cleaner, and fig. 2 is a corresponding end view. Fig. 3 is a longitudinal section of the wired cylinder alone. The apparatus is carried by the framing, A, and is actuated by the fast and loose pulleys, B, the shaft of which carries a pinion, C, in gear with the wheel, D, fast on one of the large collar bearings of the wire cylinder, E. These collars, F, are open to admit and discharge the grain. The pair of wheels, G, actuate the spindle of the cleaning stones, and the screws, H, which fit the interior of the collars. The grain supplied at one side by a vertical channel, is taken into the wire cylinder by the screw, H, the cylinder being driven at a slow rate upon its anti-friction pulleys, I, whilst the stones, J, are worked at a sufficient velocity inside the cylinder, to keep the grains in quick motion. This action loosens the dirt and husks, driving such foreign matters through the wires by centrifugal force, thus preventing them from again mixing with the cleaned wheat. The opposite screw then discharges the grain in its cleansed state.

Fig. 3.

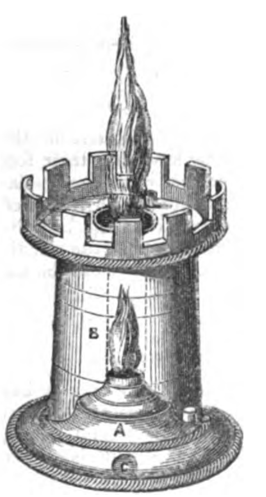


POCKET STOVE.

Registered for Mr. P. Rigby, *Liverpool.*

Six inches high, and two pounds weight, this stove might easily be lodged in the pocket, if such a mode of conveyance were comfortable or desirable. It is intended for cooking by the aid of the combustion of vaporised spirits. Its form, as represented in our quarter size sketch, is that of the magnified castle of the chess-board. The vaporising heat is derived from the lamp, A, in the base, the flame from which, passing up through a central chimney, heats the barrel portion, or spirit reservoir, B. The vapour escapes from the top of the barrel by a ring of holes surrounding the top of the chimney, and is ignited by the heat of the flame from beneath. The surmounting battlements form a gallery for the reception of the utensil to be heated, and the heat may at any time be adjusted by simply turning a small regulator at C, in the front of the base.

It is capable of boiling a quart of water, or of cooking a fowl or steak in a very short time; and, when fitted with the proper accessories, it forms a most important piece of furniture for the sportsman, the tourist, or the emigrant.



1-4th.

PAPER-CUTTING MACHINE.

Registered for Mr. James Black, *Edinburgh.*

We have already noticed Mr. Black's ingenious folding apparatus,* which attracted some attention in the Exhibition, from its clever folding of printed sheets of paper. Since that period he has introduced his equally effective paper-cutter, with its circular traverse movement for the knife. The front end of the table carrying the paper to be cut, has attached to it two long circular guides, or metal segments as guides, for the traverse of a segmental toothed rack, which is capable of being actuated by a winch-handle and train of gearing at one end. To the under side of this rack is attached an eccentrically curved knife, which, when drawn across the pile of paper, held down by a binding-screw beneath, gives a powerful and clean cut.

NEW FORMS OF BRICKS.

Registered for Thomas Paris, Esq., *Greenwood, Barnet.*

Mr. Paris' new forms of bricks are secured under two distinct registrations. Both designs have been contrived for the purpose of obtaining a better system of binding when the bricks are built together, whilst by expanding or contracting the lap, two bricks will form either a 9 or a 14 inch wall, and they may be made to produce hollow air channels in the centre of the walls built with them. Figs. 1 and 2 are transverse sections of the two forms, and fig. 3 is a perspective view of a portion of a wall built of bricks of the form fig. 2.

Fig. 1.

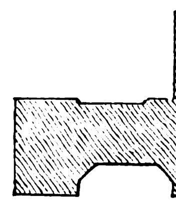
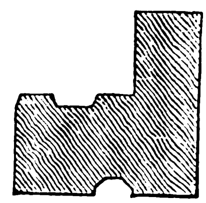


Fig. 2.



The binding powers of bricks of these sections are so strong that they may be put together with the mere addition of a little dry sand, so that the erection may be removed at pleasure, whilst the bricks are quite uninjured by being put to use. Tenants who may wish to make use of temporary buildings will find them very convenient, inasmuch as buildings so put up are not fixtures in the legal acceptation of the term. As they are solid, they may be made of any kind of clay, and may be burnt in clamps. Mr. Paris also uses a third section—a plain brick, fig. 4, recessed slightly on each side, for building with fig. 2, when a wide wall is required. The same section also forms a surface gutter when reversed.

Fig. 3.

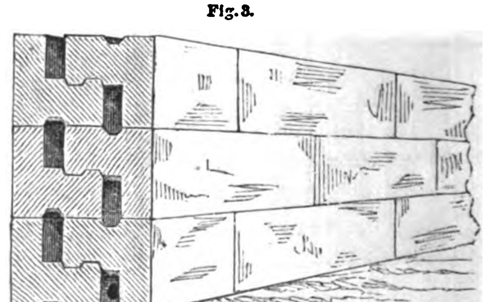
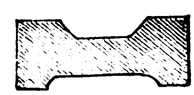


Fig. 4.



COLUMBIAN PRINTING PRESS.

Registered for Mr. T. Cobb, *Portugal Street, London.*

Mr. Cobb's design is a modified form of what is known among printers as the "Columbian Press," and refers,—

1st, To arranging the carriage upon a V-shaped bearer to work in corresponding grooves in the ribs, to reduce the friction.

* Page 83, *ante.*

2d, Dispensing with the "Eagle" and "Lady" levers, the return of the platten being effected by a stout blade-spring fixed under the beam.

3d, Dispensing with the bolts for the links which actuate the main beam, as well as in the pivot for the bar-handle, which parts are made to work on centres set in oil-cups.

4th, Fitting the coupling-bar with an adjusting screw at each end, so that each turn of the bar may bring the connecting joints nearer by two threads, instead of only one as at present.

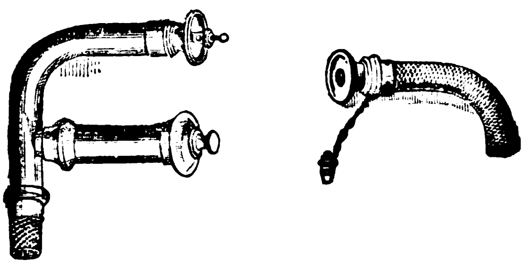
5th, Simplifying the construction of the head by making the beam centre work in an oil-cup, and doing away with the bolt and four screws of the old form.

It will thus be seen that Mr. Cobb gets rid of some of the stupid ornaments which encumber the hand-press, whilst he diminishes the weight and lessens the workman's labour.

TELEKOUPHONON FOR SPEAKING-PIPES.

Registered for MR. F. WHISHAW, *London.*

This invention is intended to facilitate the introduction of speaking-pipes into all buildings, either public or private. It consists of a whistle mouth-piece of ivory, wood, or metal, with an indicator or button in the centre of the whistle, which is forced out whenever the whistle is blown into from the other end of the speaking-pipe—thus showing at once from whence a whistle proceeds—a result which has hitherto been unattainable, whenever two or more whistle mouth-pieces are fixed side by side.



The lower part of the left-hand figure shows another part of the invention, by which is superseded the necessity of blowing with the mouth to sound the whistle. It consists of a brass cylinder, with a piston in it, moved by means of a china or other knob, and mounted so as to present all the appearance of a bell-pull.

It is the invention of Mr. Francis Whishaw, so well known for his many telegraphic improvements, and the originator of the "Telekouphonon," and is made by Messrs. Kepp of Chandos-street.

REVIEWS OF NEW BOOKS.

OBSERVATIONS UPON THE NATURE, PROPERTIES, AND VALUE OF THE PATENT SOLID SEWAGE MANURE, &c. Pp. 16. London: Weale. 1851.

This pamphlet, which bears the signature of Mr. Wicksteed, the well-known engineer of the East London Water-works, also comprehends "a description of Wicksteed's patent process for its manufacture, and a statement showing the origin of the scheme for removing the sewage of the metropolis and other towns, by means of a tunnel sewer having an artificial fall." It treats of a subject which our past experience has over and over shown to be a very difficult one, although somewhat of a favourite with the professed pamphleteer. Many a ream of good paper has been sacrificed, and many a midnight hour has been wasted, in the vain endeavour to light the visionary's way to wealth and greatness, by dull expositions of our heedless waste of fertilizing products.

Much of this is unquestionably owing to the often-quoted example of the Edinburgh Meadows, an isolated case that has much to answer for in causing precipitate leaps at false conclusions. By a rare combination of favourable circumstances only is it, that the Edinburgh landholder has attained such results. Elsewhere the cost of carrying the liquid would, in most places, far more than outweigh the value of the fertilizing matter. So diluted is sewer water generally, that, from an analysis made by Professor Aikin in 1845, it was found that 560 tons of the liquid actually gave no more than 1 ton of fertilizing matter; and even where the liquid can be cheaply conveyed to the land, we must bear in mind that the soil does not benefit by any means to the full extent of even this limited return. Large portions of the suspended matter flow off to the natural ducts of the district. For example, Professor Philips found by analysis of this very Edinburgh water, that out of 52 grains of solid matter really held in suspension, only 37 grains were deposited on the land; and, worse still, out of the matters held in *solution*, which are by far the most valuable, not more than 5 per cent. was duly left in the soil.

Every one now understands the failure of the system of supplying the liquid by forcing through pipes. We are then driven to the principle which Mr. Wicksteed here advocates—the manufacture of solid manure. At the suggestion of Professor Aikin, he adopted milk of lime to deprive the fluid of its disagreeable odour, as well as to precipitate the most valuable of the salts and organic matter held in solution. The actual process of manufacture is detailed in the following extract from the pamphlet before us:—

"The arrangements having been made for separating large floating bodies, stones, &c., from the sewage water received at the outfall, it is then pumped up continuously into the reservoirs, so as to preserve the necessary fall of water in the sewers; I then commence the deodorizing process by mixing the sewage intimately with milk of lime, which is made by putting into a cistern a certain measured quantity of lime, and adding thereto a definite quantity of water; both being mixed together, and kept in motion by an agitator.

"A sufficient quantity of milk of lime is to be used to render the sewage water clear and free from smell, and to insure the precipitation. To effect the due admixture of milk of lime and sewer water, I employ a pump of small bore, proportioned to the quantity of the milk of lime required; and the arrangements are such that, while the sewage water is flowing away from the large pump, it receives from the small pump, through a pipe branching on to the pipe conveying the sewer water to the reservoirs, a stream of milk of lime commingling with the sewer water in its passage. The strength of the milk of lime, or the quantity to be used, will vary with every different kind of sewage fluid. An excess, however, is not prejudicial, as it subsides with the other solid matter. The mixture of milk of lime and sewage water then flows into the reservoirs, of which there may be any convenient number; thus the liquid may be passing into No. 1, while No. 2 is depositing, and No. 3 being worked off.

"When the precipitate produced by the lime has subsided, the deposit, while in a liquid state, is conveyed by a drain or pipe to a well, where it is again allowed a certain time for subsidence, and the superfluous water is drawn off. To cause the deposit to flow into the well without the fear of the drain choking, and to create a current, I apply a screw of one or more turns within the drain, which propels or draws the deposit through it. The deposit is then raised from the well by an endless chain of buckets, or other suitable elevating apparatus, which delivers it into a horizontal trough, from whence it flows into the drying machinery, the quantity being regulated by sluices in the trough.

"The drying machines themselves, and of which there must be a number proportionate to the quantity of sewage obtained and to be dried, perform the operation by means of centrifugal force, arising from the machines being made to revolve with great rapidity. The construction of the machine, and its operation, are as follow:—

"A vertical shaft carries a horizontal plate, about 3 feet diameter, keyed upon its upper end; connected with this plate, and concentric with it, is a ring or drying cylinder, about 18 inches diameter, of wire gauze or other perforated material. This cylinder retains the manure while the water is thrown out through the wire gauze by the centrifugal force caused by the rapid revolution of the shaft. If now the machine were stopped, the dried manure might be dug out by manual labour; but, to save this expense, and to economise the time required for stopping, I have adopted a contrivance by which the drying cylinder can be raised up from the horizontal plate while both are in motion; and, as this cylinder is raised, the dried manure flies off through the space left between the cylinder and the plate. This refers to a *single* machine.

"A *double* machine consists of the ring of 18 inches diameter already described, and another of a similar description, but of 3 feet diameter, upon the same plate, and concentric with the first cylinder. In this machine, the water, instead of flying from the inner cylinder against the inner surface of the outer cylinder, as it otherwise would do, is made to flow through channels in the plate to the outer edge of the same; but when the inner cylinder is raised to discharge the manure, this is allowed to fly against the outer cylinder.

"After having in its turn performed part of the drying process, this cylinder, by a contrivance similar to that employed to raise the inner one, is also raised, and the manure allowed to fly out upon the floor, or into a casing fitted to receive it. The means of effecting the raising the cylinders can scarcely be made intelligible without drawings, but perhaps the general idea of the action is sufficient for the present purpose.

"Motion having been given to the machine, the manure, in a state of very liquid mud, is introduced by a pipe from the horizontal trough before-mentioned, into the inner drying cylinder, in which, by losing much of the water, it becomes solid, though still damp. This cylinder being raised, the manure flies out into the outer cylinder; after which the inner one is again lowered, to be ready for another charge. The drying of the first charge is now completed at the surface of the outer cylinder; and this in its turn is raised and discharged. Meantime a second charge has been run into, and is being partly dried by the inner cylinder; so that the drying operation is beginning upon *one charge* in the inner cylinder, while it is terminating on the *previous* charge in the outer cylinder.

"The advantage of this process, in addition to that of economy of time, is, that the inner cylinder provides a moderate velocity in the first stage of the process, when the mud is very liquid, and the outer cylinder finishes the same by the greater linear velocity of its surface. Moreover, the thickness of the ring of manure will be less in the outer cylinder than that in the inner; so that the moisture from this cause will suffer less obstacle to its outward progress, which is a matter of great moment, inasmuch as the *finishing* of the drying is the part most difficult. In order to break up or divide the manure while flying from the inner cylinder, a wire grating or riddle is interposed between the two cylinders; thus, as it were, exposing a fresh surface of the manure to the drying action of the outer cylinder. These

machines are arranged in lines, so that one shaft may drive several machines. The dried sewage as it falls from the machines slides down a sloping board, or is scraped into a trough in which revolves a long screw or creeper, by which it is conveyed to a chamber, where it is packed at once or retained in store."

Everything, of course, depends on the cost of manufacture in this way. By it we get a highly concentrated manure, in a state which fits it for easy conveyance to any reasonable distance, and we save our rivers from the gross contaminating influence by which the Irk, Irwell, and Medlock, at Manchester, the Aire at Leeds, the Soar at Leicester, the Mersey at Liverpool, and the Clyde at Glasgow, are now each and all affected.

As some light on the subject of profit and loss, Mr. Wicksteed furnishes a tabulated statement of the returns from various populations, ranging from 10,000 up to $2\frac{1}{2}$ millions. With a population of 200,000, he takes the obtainable manure at 25,240 tons; cost of works, £31,500; cost of manufacture, £22,000; net income, at £2 per ton, £28,480; and the relative price of the manure to yield a return of 40 per cent., 27s. 5d.

To show his claims to the credit of originating the system of removing the sewage by means of a tunnel sewer, Mr. Wicksteed says—

"In September, 1841, Major Baeyer was sent as a commissioner to this country, by his Majesty the King of Prussia, for the purpose of ascertaining, amongst other things, how the city of Berlin could be efficiently sewered. He informed me that no portion of the city was elevated more than 10 or 11 feet above low water in the river, and that, after consulting several gentlemen, he had been told, that on account of there not being a sufficient fall in the river, a complete sewerage could not be introduced; and he requested me, therefore, to consider if the difficulty were insuperable, and, if not, to inform him what I should advise to be done.

"In October, 1841, I reported to him, that if a large and deep reservoir were sunk at a distance from the city, to such a depth as would allow sufficient fall for the sewers in the city, and if they were connected by a main sewer to it, steam-engines might be employed to raise the sewage water flowing into the reservoir, so as to preserve the low water level required for the fall in the sewers; and the object he had in view would, I was of opinion, be thereby effected. I also said, that although there would be, by this plan, an annual expense incurred for working the machinery used in the raising the sewage water, nevertheless, that this expense would be more than counterbalanced by the profits arising from the application of this water to the manuring and fertilizing the land in the *immediate* neighbourhood of Berlin, which he represented to me as being, for a great extent, arid and barren.

"This, I believe, was the original suggestion for what I have termed an 'artificial fall,' as applied to sewers; and I may remark, that as the power of obtaining the most advantageous fall is thus acquired, a velocity may be maintained in the sewers which will allow of a sufficient scour to prevent accumulations of filth at the bottom; and although the plan involves an annual expenditure in pumping, it by no means follows that it is therefore more expensive as regards the metropolis, than those plans in which large tunnel sewers, running along the banks of the Thames, and having only the natural fall of the river, are proposed to be employed; for in them the natural fall would be insufficient to produce a sufficiently rapid velocity, and, in addition to the expense of a much larger sewer, would have to be added that of the contrivances necessary to prevent the accumulations of deposits. Hence the outlay would be so much less upon the smaller than upon the larger sewer, that the annual saving in interest upon capital would more than counterbalance the extra cost of employing machinery.

"Having, in the spring of 1845, fully analysed and considered the merits and demerits of a scheme for distributing the contents of sewers, 'by means of a system of pumping engines and pipes analogous to that of the great Water Companies;' and having satisfied myself that this plan would not yield sufficient profit to encourage private enterprise, and that therefore it should not be adopted by the public with the hope of reducing rates and taxes, I therefore suggested a tunnel sewer, as I had previously done to Major Baeyer for the city of Berlin; this, however, did not meet the views of the projectors."

There is much valuable information compressed within the few pages from which we have quoted; for the author has wisely said what we had to say, without an undue expenditure of words. When Mr. Wicksteed writes on such a subject, he has a right to be heard; and few readers will find him tedious.

The Paper-Hanger's and Upholsterer's Guide, &c. By James Arrowsmith. 12mo. Pp. 70. London: Dean & Son. 1851.

The author, now the Librarian at the Bedale Mechanics' Institution, Yorkshire, writes as a practical man, and gives us his little volume as the result of half-a-century's experience. Following out a principle which might afford a hint to many writers on loftier subjects, he "begins at the beginning," and thinks no one point too trivial to deserve its proper explanation. From the tools and paste for paper-hanging, "to colouring in distemper," and the decoration of "state-rooms," he travels over the minute details of his work with the care of an assiduous teacher.

On the preparation of "grounds affected with damp," he gives no fewer than nine short chapters—"battening for lath and plaster" being his favourite remedy. Ivy has often been condemned as injurious to exterior walls; and thus this most charming of all outward adornments has been in many cases cast aside. Let us see what Mr. Arrowsmith says on the point:—

"The last thing I have to mention on the subject of damp, relates to ivy on exterior walls of buildings, which may be said to belong more to the consideration of the architect than to my purpose; but as precaution is allowed to be better than cure, I trust it will not be thought irrelevant to notice its effect on internal walls, which is, that if it does not entirely eradicate damp, it may be admitted to be a repellant placed on the exterior.

"I had my attention drawn to a case of this description, where damp had prevailed for a length of time in the walls of an apartment, but ivy having grown up, to cover the opposite exterior side, the affected parts inside had become dry.

"The gentleman in whose house I observed the improved change accounted for it, I think with much reason, viz., that the close overhanging pendent leaves prevented the rain or moisture from penetrating to the wall, contrary to all other trees which are trained for bearing fruit."

The Appendix to the volume is devoted to the consideration of general internal decorations, with "a table of festoons" for the guidance of the practical upholsterer.

The Machinery of the 19th Century Illustrated from Original Drawings, and including the best Examples shown at the Exhibition of the Works of Industry of all Nations. By G. D. Dempsey, C.E. Part I. London: Atchley & Co. 1852.

To represent the machinery of the 19th century is an ambitious project. Mr. Dempsey's work—the first part only of which is at present published—seems carefully got up, and the plates are well executed; but we are afraid the price at which it is published will preclude its dissemination to any very great extent amongst "practical mechanics."

Part I. contains five large folio plates of Bishopp's disc engine by Rennie, Clayton's tile machine, Fairbairn's tubular crane, and Clymer & Dixon's patent Columbian printing press—with descriptions of them in a separate form. The descriptions are clearly written; but if the work is not too far advanced, we would suggest to Mr. Dempsey that the machinery would be more readily understood, were the several parts lettered, with corresponding reference to them in his descriptions.

CORRESPONDENCE.

CLARK'S RAILWAY MACHINERY.

I observe, in your second notice of my work, that you have offered some objections (page 256, *ante*) to the terminology employed in my discussions of valve-gear. You have, I think, misapprehended my definitions, for, in the first place, you state that I have substituted the term *advance* for *lead*. If you will refer to page 31 of the publication, you will find that I retain the prevalent signification of *lead*, namely, "the width of the opening of the steam-ports for the admission, or for the release of the steam at the beginning of the stroke;" and also, that I distinguish *outside* and *inside* lead, in the terms in which they are most commonly expressed, though I am aware that "lead of induction" and "lead of eduction" are phrases also in common use.

I employ *advance*, in imitation of French engineers, to signify the amount by which the eccentric or the valve is removed from its middle position, when the piston is at the beginning of the stroke, distinguishing the *angular* advance of the eccentric from the *linear* advance of the valve. The advance of the valve is then equal to the lap plus the lead; and it is therefore, in all cases, greater than, and distinct from, the lead. I may add that *advance* is not a substitute for any other term, as, so far as I know, there has been hitherto no English word in general use to express the sum of the lap and the lead.

Again, towards the end of the second extract which you have honoured me by transferring to your pages, you state that what I have called the *period of pre-admission*, means, in the old vocabulary, the "lead of induction." It cannot be so, for the "periods" distinguished by me refer to the motions of the piston, while "lead" refers exclusively to the motion of the valve. The period of admission means, in fact, that part of the return-stroke of the piston, which remains to be described at the instant the port opens for the admission or "induction" of steam for the succeeding steam-stroke.

D. K. Clark.

Edinburgh, 3d February, 1852.

P.S.—In your first notice, you have found it necessary to criticise my very mechanical attempts at metaphor. I thought I was very safe in creating a "child of necessity," seeing that "necessity is the mother of invention."

[I do not perceive that there is any symptom of misapprehension of Mr. Clark's definitions in the remarks to which he refers. He seems to suppose that *lead*, in the unqualified sense of the term, means *lead of port*. This I admit is sometimes, but not generally nor properly, the case: such a definition is only a confused notion among those of the profession who have not thought systematically on the subject. Among those

whose notions are somewhat matured and precise, the following are, I believe, the received definitions:—

Lead of the Valve, what Mr. Clark calls *linear advance*, is the distance which the valve is beyond its middle position at the instant the piston is at the beginning of its stroke. It is the geometrical sine of the *angle of lead*, or Mr. Clark's *angular advance*, of the eccentric.

Lead of the Port, or, for shortness, *port-lead*, what Mr. Clark calls *lead* unqualifiedly, is the quantity by which the lead of the valve exceeds the lap; it is therefore the quantity by which the port is open at the beginning of the stroke.

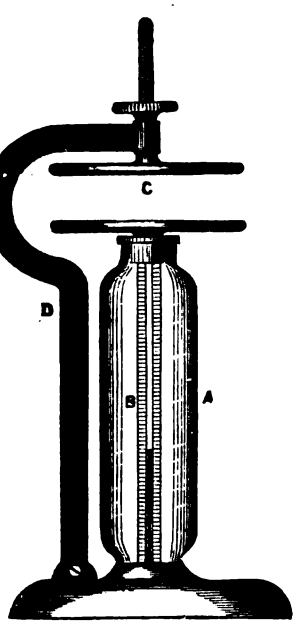
Lead of Induction, what Mr. Clark calls the *period of pre-admission*, is the fraction of the stroke which is yet to be performed when the valve is line-and-line with the edge of the steam port and opening; or it is the distance of the piston from the end of its stroke when the steam port begins to be unmasked, and the steam begins to be admitted before it.

Lead of Eduction, what Mr. Clark calls the *period of exhaust*, is the fraction of the stroke yet to be performed when the port behind the piston begins to be opened; or the distance of the piston from the end of its stroke at the instant the steam behind it begins to escape.

These definitions seem to me sufficiently distinct; and the phraseology is certainly much more familiar to our ears than the terms employed by Mr. Clark. I still admit, however, as in the paragraph to which Mr. Clark's remarks have reference, that authors possess the right of choosing their own terms, but reviewers have an equal right of expressing their opinions on the use they may make of the acknowledged prerogative.

THE REVIEWER.]

MATHESON'S ELECTROMETER.



I beg to lay before you a sketch of an electrometer of my invention, which I think will be found useful by such of your readers as may be interested in electrical manipulation. A glass cylinder, A, about three inches in length, is open at one end, to receive a capillary tube of glass, and a graduated metallic scale, B. The condenser, C, is attached to the upper curved end of the conducting support, D, which is hinged by its lower straight part to the base beneath. When the instrument is put to use, a little coloured acid is poured into the foot of the tube, and of course the fluid column rises in the small tube (open at both ends), by capillary attraction, to a height dependent on the bore; then, by presenting any electrified body, the fluid will sink to the distance due to the intensity of the charge—the amount of which is at once read on the scale.

HENRY MATHESON.

Plymouth, Feb., 1852.

[Our correspondent's ingenious arrangement secures peculiar delicacy of indication, whilst it involves no additional complexity. It will be a welcome assistant to the electrician.—ED. P. M. JOURNAL.]

SHARP'S LOCOMOTIVE SLIDE VALVE.

"Helix Junior" seems to consider it to be "quite legitimate" to take a portion of a sentence apart from its context, and found his arguments on this alone. My introduction of the words, "in locomotives the pressure is seldom less than 100 lbs. per square inch, being about double the pressure in use not more than ten years ago," was simply for the purpose of showing that the evil was an increasing one; and if "Helix Junior" had known anything of the properties of steam, he would at once have perceived that eight times the quantity could not be compressed into the same volume at only double the pressure, and that if I had been contrasting steam of only double the pressure, at five times the velocity of piston, I would then have said 2×5, and not 8×5.

I am sorry I have made a misquotation in the word force for effort—not because it would have affected anything I have stated, but because it has left a loophole, which "Helix Junior" seems inclined to mak the most of. But unfortunately for him he has not left us to gather his meaning from that little word; for he gives us (in what from his introductory remarks we might have expected would be a masterpiece of "sound" reasoning) a calculation on the motion of steam, in which its elastic properties are quite thrown overboard. In his last communication he says—"That the force increases with the pressure is a truism, for force and pressure are in this case synonymous; but the *effort* refers to what is required to be done with the given force or pressure." Now, if we have eight times the quantity of steam in any vessel, we have consequently eight times the quantity of work to perform in discharging it. He says further, that "the pressure of strong steam has a greater command over the mass of steam to be expelled, and sends it forth with greater velocity than that of weak steam is able to do." Undoubtedly it does; but then "Helix Junior" should consider that it has the same *great increased resistant action* on the piston, that it has in expediting the exhaust. To make this more clear, we may refer to his former communication, in which he says, that "for the steam to fly before the piston with sufficient celerity to give a free exhaust, it must leave the orifice at 12 times the speed of the piston," or "12,000 feet per minute." Now, to discharge the steam in this dense volume, supposing it to be at 100 lbs., the piston would require to follow up the escaping steam with an *equal pressure*.

But now that "Helix Junior" has condemned my reasoning on the motion of steam, as being unsound, what new theory has he to give us to supply its place—as the one he formerly gave us, where the higher the pressure the more rapid the exhaust, was at least clearly implied, he has now himself ignored? Now, it is not usual to pull an old-established theory to pieces, without at least having some other to substitute in its place. Is "Helix Junior" then prepared to tell us in what degree does the resistance encountered by the piston in expelling steam increase, other than that which has always been considered to be in proportion to its pressure? He ought at least to endeavour to supply us with one; and I certainly would advise him to try, as with a second *effort* he may be more successful.

He says, "This I do know, that with Stephenson's ordinary proportions of cylinder and valve, having 1 inch of lap, $\frac{1}{4}$ inch of lead, and $4\frac{1}{8}$ inches of travel, with a $4\frac{1}{4}$ inch blast-pipe, a practically perfect exhaust may be, and is obtained at speeds of 40 miles per hour." Now this statement is worth nothing, unless "Helix Junior" had furnished us with the pressure of steam at the commencement of exhaustion. True, he says, "I prefer comparing the back pressure with the pressure of the steam in the cylinder while being admitted." Surely he must perceive the absurdity of this. The question is, are the present slide-valves capable of exhausting high pressure steam, without a serious amount of back pressure? "Helix Junior" says they are, and he desires to prove it, by admitting the steam at say 80 lbs., and working it expansively, it may be, to 15 lbs., when it is clear that the required area of ports may only be of the low pressure dimensions, to insure an equally free exhaust.

There are, however, other evils, resulting from the small outlet afforded by the slide-valve, which have not yet been taken into consideration. I allude to the early exhaust, and the lengthened compression. The former we could not have expected "Helix Junior" to notice; but the latter compression he appears to have entirely omitted in his statements of the amount of back pressure. Now, I readily admit that much has been done to lessen back pressure, by giving the valve motion that advance or lead on the piston motion which it generally now has, thereby commencing the exhaust at a period considerably prior to the termination of the stroke, and by the addition of the outside lap to the valve, permitting this to take place without a too early admission of the steam. But having stated this much, we can only say it was making the most of what was found to be a very inadequate apparatus for the purpose required of it, and of which the change required to be made in its arrangements is the undoubted proof. We have then evidently to add to the remaining back pressure the loss arising from an early exhaust and that arising from compression.

As regards the loss arising from compression, we had better allow "Helix Junior" to speak for himself—as, I suppose, he will not reject his own evidence, in which he says—"Moreover, the higher the degree of expansion, the sooner does the exhaust side of the valve close the port for the escape of the steam, and therefore the greater the amount of steam detained and compressed, until for the utmost expansion the compressed steam may actually exceed in pressure the steam from the valve-chest, and be *pushed out of the cylinder*." True, this refers only to the "utmost expansion," or when the engine is working at the highest degree of expansion obtainable from the link motion; but then compression commences with a very considerable minimum amount when working in full gear, and increases at such increased degree of expansion, until at the

highest it attains the amount shown by "Helix Junior." Now, it must be clear that this compression must have a powerful effect in lessening the economical results which otherwise would accrue from working expansively. If we turn our attention from the exhaust to the steam side of the piston, we find that, even when workingfull gear, a very considerable loss arises, in consequence of the early abstraction of the steam, and that this loss goes on increasing with the increased expansion, in a similar ratio to that of compression. But it has been said in excuse for the early exhaust, that the stronger steam is necessary and desirable for the purposes of the blast; but I cannot think that even "Helix Junior" will support this assertion, as he will at once perceive that if compression were removed, and the steam retained to exert its expansive power longer in the cylinder, more work would then be done with less steam; and if the blast became less efficient, as it would, this would only be desirable, as the generation of steam would require to be less rapid, from the diminished quantity demanded.

In conclusion, I would recommend your correspondent not to permit his evident affection for the "elegant" lap, and its appendages, to blind his eyes to its more manifest defects, and would advise him to bestow a more comprehensive study on the subject, when, I have no doubt, he will find that the position he has assumed, in maintaining that the exhaust ports are quite large enough for the purpose required of them, is quite untenable, and that a valve which shall give a free exhaust, without a *too early opening*, and a cut off of the steam, without at the same time *an early closing of the exhaust ports*, is a desideratum not only for locomotives, but for all high pressure engines, which require to work at any considerable velocity.

W. D. Sharp.

Swindon, Jan., 1852.

BORING MACHINE FOR JACQUARD HOLY-BOARDS.

I have invented, and have for some time worked, a boring apparatus for making the necessary minute perforations in the "holy-boards," or guide frames, for the cords of Jacquard machines; and as I find it a most effective contrivance, I shall be glad to see it made more generally known by publication in your pages. The ordinary machine at present in use by Jacquard machine-makers, even with all the advantages of a good driving power, is of slow operation, and requires very particular attention to produce even respectable work; and, with all possible care, the work is much inferior to that of my self-acting machine, although I only employ manual power upon it. It may be made to bore three or four holes at once; but, so far, I only work with a single boring bit; and my own experience shows that a boy is capable of performing with it three times the amount of work usually accomplished by a man in the old way.

Practical men, who are accustomed to the working of the old machines, will appreciate the non-liability to derangement of the new one, when I explain that the bit is invariably drawn out of its hole after a bore, before the board receives its next shift. The boring head shifts across the board for dividing the holes, and the board itself shifts for the divide lengthways—this shifting action being accomplished by the stepped graduated edge of a cylinder or drum, which advances a notch or step for each hole.

A prominent defect in the old apparatus is the bursting of the holes in the back of the board, by the rustling through of the bit when near the end of its work. This objection, which is inseparable from the old system, is perfectly removed in mine, as the traverse of the boring bit is independent of the attendant's manual pressure. It makes with perfect ease 6,000 or 7,000 holes per hour, the size varying, of course, with the relative fineness or "pitch" of the work—say from 15 to 17 wire guage.

The wood usually employed is plane-tree, ½ inch thick. The two side rows are 2¼ inches asunder; and in that width, and within a length of 37 inches, there are often as many as 4,800 holes, although they vary down to 2,800.

Joseph Hood.

Newmilns, Ayrshire, Feb., 1852.

[Our correspondent has favoured us with a sketch of his machine, which, however, is not a suitable subject for engraving. Its arrangement appears fully to bear out all the writer has advanced in its favour.—Ed. P. M. Journal.]

THE CHAFING OF SUBMARINE TELEGRAPH WIRES.

Great difficulty having been experienced in the case of the Dover and Calais Telegraph, in effecting the satisfactory junction of the cable with the shore wires on the French coast, by reason of the chafing action upon the rocks, I may, perhaps, be excused for offering some remarks on the subject, seeing that a still grander project is contemplated in the establishment of telegraphic communication between the English and Irish coasts. In the measures which have been adopted in the case to which I have alluded, some dependence must necessarily be placed on the flexibility of the cable to avert serious consequences. Now it is generally allowed that the action of the waves ceases at certain limits. I would therefore enclose the cable, at each junction with the land, in a tube, of a bore somewhat larger than the cable's diameter, and sink such tube so as to cause it to accommodate itself to the bottom surface, where it may be fastened or weighted down—the lower or seaward end of such tube being bell-mouthed, whilst the other is carried above high watermark on land. The cable might have a spiral thread or worm of gutta percha, so as to keep it from the sides of the tube, at the same time allowing the water to find its level within. I think this system of connection would quite do away with the rocky difficulties experienced off Cape Grisnez.

To turn to another subject: Why are locomotive boiler tubes made cylindrical, when an oval section would expose such a superior amount of heating surface? Would the oval not have sufficient strength?

Tau Alpha.

Feb., 1852.

[Oval tubes would be more expensive to make, more difficult to fit up, and would certainly be weaker than the cylindrical ones.—Ed. P. M. Journal.]

LOCOMOTIVE MECHANISM IN THE GREAT EXHIBITION.

Your correspondent, J. F., in your last number, cannot see how, by shortening the travel of the valve, the port opens sooner, *even with constant lead*. If he will construct the model of a link-motion, he will be able to satisfy himself that it does so, without troubling himself with general considerations on the subject. In the meantime, allow me to refer to the third part of Clark's Railway Machinery, in which the author shows that, with 1 inch of lap, and $\frac{1}{16}$ of lead (constant), when the travel is shortened from 5¼ to 2⅝ inches, the port begins to open for steam at from 0.4 per cent. to 12.25 per cent. of the stroke, as shown in his 5th table; that is, the port opens sooner as the travel is shortened, even with constant lead. In a link-motion, the influence of the back eccentric, alluded to by J. F., does not materially affect this conclusion, as it so happens that the link-motion is similar to its action on the valve to a single eccentric giving the same travel—a conclusion which has been very fairly drawn in the work referred to, and is, I observe, alluded to in your review of that work.

It is not true that engines start better with ¼ inch lead than with $\frac{1}{16}$ inch; because the more lead you give to the valve, the sooner does it cut off the steam, the less is the charge received, and the *less freely* does the engine start. Accordingly, "it is found in practice," that engines of which the valve-gear is worn to a certain extent, start better, and with heavier loads, than when the gearing is new, and this is because the engine looses her lead as she wears, is longer of cutting off the steam, and therefore gives a greater charge.

It is, however, true that an engine runs at 30 miles an hour more easily with ¼ inch than with $\frac{1}{16}$ inch lead; because, in the former case, there is more inside lead, a better exhaust, and less loss of steam-power in the cylinder by back pressure. Also, with the greater lead, the steam is sooner cut off, and it also exhausts sooner, before the end of the steam-stroke, which is likewise favourable to the reduction of back pressure. This is what I maintained in my last communication, where I stated that an addition of lead improved the exhaust. It is also true that an addition to lead for higher speeds would be advisable, *if you work all the time in full gear*. But, in the first place, that cannot be done in any ordinary link-motion: the lead is unalterable so long as you place the reversing lever in the same notch, and the lead in any case can only be increased by shifting the lever so as to *cut off and exhaust earlier*,—and it is precisely in these circumstances, I repeat, that an increase of lead is not wanted; because, as I have always urged, the *earlier* exhaust letting off the *smaller* charge of steam, banishes the back pressure, which is all the good that can be got by adding to the lead. Secondly, in engines suited for their work, and having a link-motion, full gear is employed only at starting: at 30 and 40 miles, the steam is usually cut off at two-thirds, one-half, or one-third stroke, by means of the link-motion; and therefore the increase of lead required by J. F.—desirable only for full gear at high speed—is not in actual practice required.

J. F.'s proposition, it follows, is improperly put—"Does an engine, working at a moderate speed, work economically with a ¼ inch lead?

If so, then an increase of speed necessitates an increase of lead?" And his conclusion is illogical, as he ought, before jumping to it, to have satisfied himself that there was no circumstance but that of speed to influence the solution of the question. And even though his deduction were logically drawn, it would be impracticable, with any existing link-motion, to vary the lead, while the steam is cut off at one place.

J. F. wishes to know what I was arguing about when I stated, in my last letter, that the higher the degree of expansion, the more exhaust steam is detained and compressed. I was just discussing Justitia's argument about the advantages of increasing lead with the expansion, one of which he stated to be, that it gave a better admission of steam; and I wanted to show, which I think I did, that increasing lead was not wanted for this purpose, as with great expansions there are great quantities of steam detained and squeezed up ready-made, "equal to bespoke," at the pressure in the valve-chest, by which the cylinder is thoroughly primed for the next stroke, and by which the steam gets a fair start with the piston.

J. F. also appears to confuse the exhausting of steam with the compression of steam. They are quite distinct, and there is this difference, —that whereas back pressure due to exhaust is dead loss of power, back pressure due to compression is not so, as the steam thereby kept in is employed in the next steam-stroke doing work. A perfect exhaust is therefore quite compatible with great compression.

Lastly, J. F. supposes that I have changed of late, because I said that provision for cutting off steam equally for the back and front strokes is a mere detail; while, in my first letter, I stated that "this, with constant lead, constituted perfect action." The old story of garbled quotations. I said that *so far as link-motions differ*, this was perfect action, when I wanted to show that Hawthorn's link was not so good as some others. And, in my last letter, I called it a mere matter of detail, in contradiction to Justitia, who denied the facilities which exist in all links for cutting off equally.

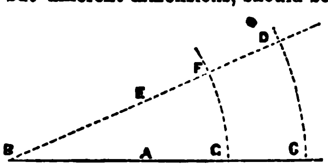
This, Sir, is but a paper of explanations, equally tedious in the writing and in the reading, I am sure. If correspondents will not take the trouble to understand what they read, it is no fault of mine; and I trust I shall not again have to monopolise your pages on this matter.

HELIX JUNIOR.

February, 1852.

PROPORTIONAL SCALE FOR REDUCING OR ENLARGING OBJECTS.

I have found the following simple plan very serviceable in determining the relative proportion of the details which two objects of the same form, but different dimensions, should bear to each other.



On a line, A, and from B as a centre, the horizontal length or base line of the known object or drawing is set off, and a portion of a circle struck, as C, D, this being the corresponding vertical dimension given. Then from this point a line, E, is drawn to the centre, A; and by bringing the length or breadth of any point of the object to be drawn as a radius to the lines, A, E, from the point, B, the distance included between the line of intersection, as F, G, gives the proportion required.

H. MATHESON.

Plymouth, Feb., 1852.

[This appears to be simply the "proportional compasses" reduced to paper.—ED. P. M. JOURNAL.]

LOADING MACHINE FOR CARTS.

Any simple apparatus which would relieve carters or labourers from the severe drudgery of direct lifts into and from carts, is surely deserving of consideration. With the view of providing a remedy of the kind, I have contrived a cheap inclined plane and pulley apparatus, which, I think, would answer well for storehouses, mills, and market-places. It is nothing more than an open triangular frame, forming an inclined plane of suitable gradient, and fitted at its summit with a hinged platform for connecting the incline with the cart or elevated place of receipt or deposit of the load.

A small waggon or cradle is set to run up or down the incline on four wheels, a couple of ropes being passed up from it over a guide-roller at the summit of the incline, and finally attached to a winding barrel, carried by the vertical standard of the frame. This barrel has a winch at each end, and suitable ratchet-wheels for the detention of the load. By this machine a very heavy load may be drawn up the incline with great ease, and quickly run off into the cart.

DIXON VALLANCE.

Greenshields, Feb., 1852.

GILBERT'S MARINE SIGNAL LAMP.

Fig. 1.

The value of a lamp which shall be in readiness at all times to produce a brilliant flame, is emphatically felt by every seafaring man, particularly in the channel, or when nearing a much-frequented port. The annexed figures exhibit my contrivance of a "Marine Signal Lamp," which, as a well-attested improvement, may claim a place in your pages.

Fig. 1 exhibits the lamp as closed previous to use; and fig. 2 shows the light obtained from it. It consists merely of a copper or tin plate vessel, of the size of a two or three pint measure, fitted with a cover, to prevent waste from evaporization, to which cover the wick is attached. It charges itself with the material for producing the light; and when once charged, burns for ten minutes at the cost of a halfpenny; or, if necessary, it may be kept constantly burning, without injury to the apparatus.

Fig. 2.

In the vessel is suspended, from the cover, a coil of wire, interwoven with cotton or other fibrous material, for the purpose of holding a portion of the inflammable spirit, which may be turpentine or other cheap inflammable liquid. The hardest gale will not blow out this light, nor can rain extinguish it. The metallic wick is held in the hand whilst exhibiting, as delineated in fig. 2; and it may be easily carried about the ship, or swung round, to produce a circle of flame. During the last seven years, 35,000 ships have been supplied with the lamp.

E. GILBERT.

Falmouth, 1852.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

DECEMBER 16, 1851.

"On the Alluvial Formations, and the Local Changes of the South-Eastern Coast of England—first section, from the river Thames to Beachy Head," By Mr. J. B. Redman.

DECEMBER 23.

Mr. Redman's second paper—"From Beachy Head to Portland."

JANUARY 27, 1852.

"Discussion on Mr. Redman's paper," after which Mr. Jee read a "Description of a Cast-Iron Viaduct erected at Manchester, forming part of the Joint Station of the London and North-Western, and Manchester, Sheffield, and Lincolnshire Railways."

FEBRUARY 3.

"Discussion on Mr. Jee's paper."

FEBRUARY 10.

"The Construction and Duration of the Permanent Way of Railways in Europe, with Modifications most suitable to Egypt, India, &c.," by Mr. W. B. Adams.

INSTITUTION OF MECHANICAL ENGINEERS.*

JANUARY 28, 1852.

This was the Fifth Annual General Meeting. After the usual report, Mr. Andrew Lamb, of Southampton, read a paper "On an Improved Boiler for Marine Engines."

"On an Improved Brake for Railway Carriages," by Mr. W. Handley.

"On a Continuous Expansion Steam-Engine," by Mr. J. Samuel.

ROYAL INSTITUTION.

FRIDAY, JANUARY 23, 1852.

SIR JOHN P. BOILEAU, BART., IN THE CHAIR.

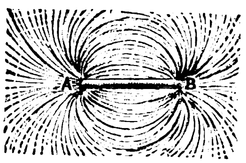
Since the foundation of this Institution, no yearly session was ever ushered in with the details of so interesting and important a discovery as that which claimed attention on this, the first Friday evening meeting of the year, by Professor Faraday's discourse "On the lines of Magnetic force."

Mr. Faraday commenced by stating that the great object he had in view on this occasion was to render as intelligible as he could, in the short time to which he was restricted, a new means, which he believed he had discovered, of reading with more clearness the phenomena of magnetism, and a new application for detecting magnetic forces, and of summing them up. From the few observations he had recently made in consequence, he considered that this subject, to which his attention had long been particularly directed, was as yet in its first infancy.

He explained, with his usual felicity, and by the aid of some simple and novel experiments, the means which the greatest scientific knowledge of the subject had hitherto pursued towards investigating the phenomena: showing that these means consisted in ascertaining the amount of attraction and repulsion as the measure of magnetic forces. This mode of accomplishing the object was, however, fraught with many difficulties, as well to the experimentalist as to the mathematician. Numerous experiments had shown the apparent correctness of many conclusions arrived at; but other experiments had shown the contrary. The mathematician had attempted to establish the law, that the magnetic force was inversely as the square of the distance. This could, however, be proved to hold good only in certain cases, where the demonstration of the force was at some distance from the centre of power; and that it was altogether erroneous where such demonstration was immediately proximate. At such near distances, indeed, the best mathematical authority admitted that there was no such law.

He proposed to consider, first, What is a line of magnetic force? second, How we may restrict its meaning; and third, How we may use it in estimating the amount of force.

He referred to some large diagrams, and showed experimentally, by means of a large cylindrical bar-magnet surrounded in one plane with a sheet of white board, the forms of these magnetic curves as produced by long nails, or iron filings, thrown carelessly around it, and which soon exhibited the beautiful figures so well known to ordinary experimentalists. It is found that such a magnet, placed in the position A B, induced the nails and filings to arrange themselves in the symmetrical manner shown.



By a very simple and ingenious experiment, he proved that the arrangement of the curves, thus shown on one plane, was equally true with regard to every plane surrounding the magnetic bar; which, therefore, formed an infinite series of circles cutting each end of the magnet, and which circles continued diminishing in size, until they appeared to coincide in the equator of the magnet. From the revolving needle which he used, it was clear that the tangent of the curve coincided with the base of the needle. Other substances might be used to prove this, as a plate of bismuth, which stands perpendicular to the curve, or a crystal of transparent spar, which assumes a transverse position. So the curve might be traced by observing where no electric current passes through a metallic wire exposed to its influence. It is all one which experiment is made. They all produce the same result in showing the direction of the curve. By means of a very rude galvanometer at hand, he proceeded to prove whether a magnet was before him or not. Now, experiments analogous to these had induced mathematicians to give up what are called the poles of a magnet as data upon which conclusions on the subject may be arrived at. And it would appear certain that, not the poles, but the magnetic curves, were the real phenomena to be regarded. He showed by experiment how, by cutting these lines by a ring of wire thrown over a magnet, he could act upon the galvanometer, and act the more upon it the greater the number of these lines of force which were thus cut; the greatest number obviously being when the wire was placed in immediate surrounding contact with the magnet. Most interesting and extraordinary results were thus produced, and indicated by the action of the galvanometer. The measure of power thus singularly obtained was shown as follows:—

Introduction.				
1	8°.		....	7°.91
2	15°.75	÷ 2	....	7°.87
3	23°.87	÷ 3	....	7°.95
4	31°.66	÷ 4	....	7°.91

where, on the 1st introduction of the power upon the galvanometer, the needle indicated 8 degrees as obtained; on the 2d it indicated 15°.75, and so on. It will be readily seen how accurately, for first rude experiments on this new point, the numbers came out, when the numbers are divided as shown above; no matter where these lines of force are intersected, the results being the same.

Every line of force was suggested to be a circle of power. Our illustrious experimentalist then exhibited an instrument consisting of a bar-magnet, placed vertically, with a metal wire attached to it, in such a manner as to allow both to turn together, or the magnet to be turned while the wire remained at rest, or *vice versa*. This being connected with the galvanometer, it was shown that when both were turned together no electric current was induced, the wire then moving in all the planes of the lines of force. But when the magnet alone was turned, the needle of the galvanometer ranged eastward, and westward when the wire alone was turned. It was asserted that every line of force continued within the magnet, and each appeared to have the same amount of power.

The most important and interesting experiments were now shown. A needle-magnet, suspended on a universal centre of motion, soon exhibited its *dip*, showing the direction of the line of force of the great magnet—the earth. The lecturer then made use of these lines of force in lieu of the artificial magnet, and demonstrably proved the correctness of the conclusions at which he had arrived, making the first experiment by intersecting the lines of force, in the position in which they lay as indicated by the dip, with a frame of wire one foot square, and a second experiment with one nine feet square. The result on the galvanometer showed that in the latter case he obtained nine times the amount of power he obtained in the former, by simply turning these wires transversely to the dip. According to the number of revolutions made, the amount of power was found to be increased, as shown in the following table:—

Revolution.				
1	7°.		....	7°.
2	13°.88	÷ 2	....	6°.94
3	21°.07	÷ 3	....	7°.02
4	28°.64	÷ 4	....	7°.16
5	37°.63	÷ 5	....	7°.52

He observed that these results, when first obtained, were so extraordinary as to make him actually fear that he was deceiving himself; so unexpectedly regular, and almost so mathematically true, were they. He concluded by pointing out what he believed to be their great importance in future investigations into the phenomena of magnetism, as affording a certain test of the presence of magnetic forces, and what he could not but consider an infallible measure of their power.

SOCIETY OF ARTS.

WEDNESDAY, JANUARY 7, 1852.

THOMAS HENRY GIBSON, ESQ., IN THE CHAIR.

Dr. Playfair referred, with great approbation, to the candles produced by the patented process of Price & Co. Some wax candles, quite white, were exhibited as produced from coal, by means of Young's recent extraction of paraffine and mineral oil from that fuel.

The last subject to which the lecturer adverted in this portion of his discourse was that of coal-gas; and in this manufacture he further showed, how simplifications had been attained by successive discoveries, and how all the disagreeable matters which attended its primary production have been annihilated by their conversion into new materials adapted to profitable use.

Having illustrated the above examples of chemical principles, Dr. Playfair proceeded to urge the necessity now existing in the British Empire, of an industrial education. With this view he would rather refer to the likely consequences than to the excellences of the Exhibition. The Exhibition, in many subjects, proved our strength, but it also exposed our weakness. We found some nations excelling us in certain productions in which we have conventionally considered ourselves without rivalry; while in others a fair equality appeared to have been attained, where we have scarcely been led to suppose attention was directed to the particular subject at all. We were a practical nation, but should remember that abstract, not practical science, is the soul of industry. In comparing our present status with this idea, he could not but consider that England was rapidly declining, and for the very cause, that we recognise chiefly the practical, not the abstract. After a most eloquent description of the habits of the recluse Cavendish, who so advanced

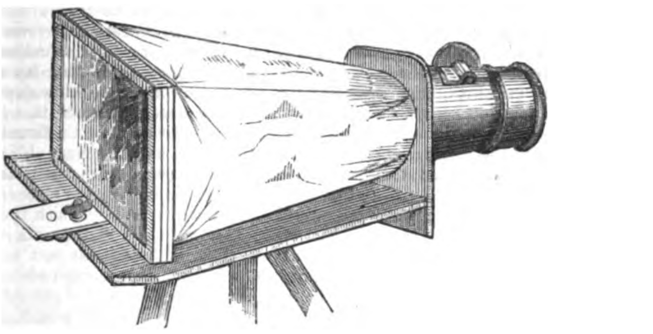
* The four first papers in our report of the proceedings of this Society, of October 22, were erroneously given under the head of "Institution of Civil Engineers."

the science of chemistry, the lecturer alluded to the rapid transition now taking place in industry, not, as he stated, by competition of local advantages, but by the competition of intellect. Regarded from this point of view, the result of the Great Exhibition was one that England may well be startled at. He referred to cutlery, plate glass, flint glass, and other things, in which the foreigner is attaining great excellence; although in earthenware and hardware we may still be supreme. The fears for England consist in observing that the *advance* of other nations is greater than our own, and inquiry, therefore, becomes of the greatest importance. Our system of education is not suited to the wants of the age. Classical education is a prejudice belonging to by-gone days. Society is constantly in a stage of regeneration, and we ought daily to regard with jealousy all conventional form in this high matter. Classical literature and science are wholly antithetical. Science has not a standard of excellence like literature, and never can have it. He looked to what unsophisticated nature teaches, and he could see all the aspirations of youth towards science, especially that department dependent on observation. Our present system is confined—the result of our remarkable unwillingness to change. England, to maintain her position in the human mind, or to restore it, has but one thing to do, which must be done, in order to prevent the justly-to-be-apprehended success of foreign competition in those articles of commerce which are dependent for their production on scientific culture. This dependence is increasing, and the establishments of industrial colleges is the only mode to be adopted to enable us to keep our place.

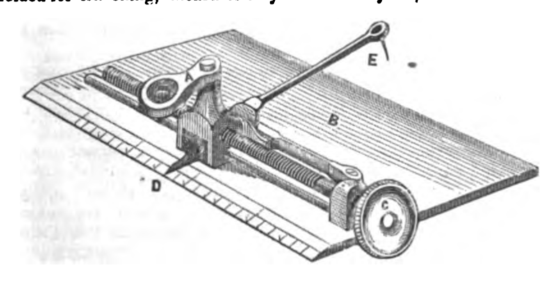
It is scarcely possible to follow the learned lecturer in all his just, profound, and eloquent reasoning. His discourse was listened to with the deepest attention by a very numerous auditory, which completely crammed the large room. We shall reserve some observations on the main subject, when the essay is before us in type, and when we shall go more fully into those portions which we have above but crudely reported.

MONTHLY NOTES.

Willats' Portable Camera and Linen Prover.—Amongst the ingenuities shown by Messrs. Willats in the late Exhibition, was a collapsable camera of peculiar lightness and portability. Our engraving represents a perspective view



of the apparatus as ready for use. The novelty consists in the expanding cloth body, and the simple method by which the paper or plate used can be placed at any angle that may be found best for obtaining a good general focus. The lenses have a fine rackwork adjustment for correcting the focus, and can also be moved in a vertical direction, to bring the object to be copied in the centre of the field. The framework at the back of the instrument is mounted on a sliding plate, which can be clamped at any distance from the lense, to enable the operator to use lenses of different focal length should he require them, and the whole camera so arranged that it can quickly be put together, or dismounted and packed for travelling, occupying less than half the space and weight of the old forms of camera; it is also much less liable to damage from extremely hot climates or moisture. The inventor states that this arrangement is best adapted for large cameras, and is especially recommended to travellers wishing to obtain large photographic views without the encumbrance of a bulky apparatus. When made without the angular adjustment, simply to take the picture in a vertical position, it is much less in cost, and the bulk is less diminished. As an example of the small compass into which it can be packed, we may state that a camera, to take a view of $10\frac{1}{2}$ by $8\frac{1}{2}$ inches, when folded for travelling, measures only 14 inches by 12, and 4 inches in depth. Our second figure illustrates another ingenious contrivance intended for ascertaining the value of any woven fabric, by finding the number of threads of, warp or weft



within any given space, from 1-16th to 2 inches. When in action, the magnifying lense A is moved along the brass plate B, by means of a tangential adjusting screw C, carrying with it the index D, which reads off the space passed over on the graduated edge of the plate. The spring index arm E, at the back, being also traversed at the same time, by pressing down the point as each thread is passed, the number may be pointed out on a piece of paper beneath. This counting is on an extended scale, 1-16th inch being spread over $\frac{3}{4}$ inch, so that it is easy to read.

Shot Towers Superseded.—An ingenious mode of casting leaden shot without the necessity for the lofty "shot towers" of Waterloo Bridge, has been patented by Mr. David Smith, a lead manufacturer of New York. Instead of these costly erections, Mr. Smith simply employs a vertical channel, fifty feet high, and twenty inches diameter, having a funnel top, and terminating in a truncated cone. The perforated metal pouring vessel is fixed in the funnel, and an annular hollow vessel is attached to the bottom of the cone, over a fluid reservoir. Into the bottom of the erection an air channel from a fan-blower is led, for the purpose of blowing a strong current up against the falling drops of lead, the top of the pouring vessel being perforated, to allow the air to pass. The air current being made to travel upwards twice as fast as the melted metal falls down, it is clear that the latter will be acted on by as much air as in falling down a tower 150 feet high. The shot falls through the centre of the annular vessel at the bottom into the water reservoir, as usual. The air current may also be created by exhaustion from the top.

Relative Cost of Different Elevating Powers.—During the execution of the works on the Birmingham and Oxford Junction Railway, under Mr. C. B. Lane, various modes were adopted, and mechanical contrivances used, for raising the materials to a considerable height, and deductions were drawn from a very numerous series of experiments, to ascertain the values for the useful effect produced by the "Labouring Force" (Whewell), or "Travail Méchanique" (Poncelet), of a man under different modes of its application, and also for a horse under alternating motion over a short space. From these it appeared that the relative costs of raising the materials to a height of 46 feet, by the horse-lift, the swing-lift, and the box-lift, were 3·08, 5·90, and 4·13 pence per ton respectively, showing a saving in favour of the horse-lift against the swing-lift, of nearly threepence per ton, and against the box-lift of rather above one penny per ton.

Small's Rotatory Safety Boat-Plug.—Mr. Andw. Small, of the Broomielaw, Glasgow, has recently fitted up the boats of the steamers *Lima*, *Quito*, *Glasgow*, *Briton*, and *Bogota*, and several sailing vessels, with a very effective and convenient safety-plug, which deserves to be made more widely known. It is represented in elevation in fig. 1, and in vertical section in fig. 2,—being in the former case closed, and in

Fig. 1.

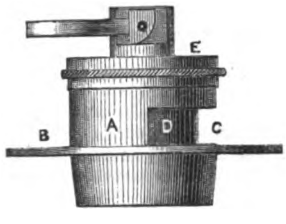
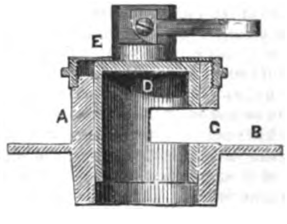


Fig. 2.



1/2

the latter open. It consists of a short cylinder or shell, A, the lower end of which is made slightly conical, and enters the boat's bottom, being held down by a wide flange, B, by which it is screwed to the wood. Just above the flange a side opening, C, is cut in the shell, extending about half round; and a corresponding port is formed in the side of the hollow plug, D, which has a slight external cone, and is ground to fit the shell. This plug is held in its place by a cap, E, screwed upon the upper end of the shell, and having a milled rim wherewith to turn it with the fingers. The plug is actuated by a ring handle, jointed to the short stout spindle—the joint being to enable it to be closed down, as shown in the figures, so as to be out of the way. When set as in figure 1, of course nothing can pass through the valve, as the solid portion of the plug is opposite the port in the shell; but when brought by a half-turn to the position of figure 2, the two apertures are in correspondence, and the water passes from the boat through the passage in the side of the shell, and is discharged by the end opening in the shell. There is nothing loose about this plug, whilst it is cheap, and apparently not liable to derangement.

Weight that can be Trusted on a Pile.—A simple empirical rule, derived from an extensive series of experiments in pile-driving, made in establishing the foundation for Fort Delaware, will doubtless prove acceptable to such constructors and builders as may have to resort to the use of piles, without having an opportunity of making similar researches. I believe that full confidence may be placed in the correctness of this rule, but I am not at present prepared to offer a statement of the facts and theory upon which it is founded. Suppose a pile to be driven, until it meets such an uniform resistance as is indicated by slight and nearly equal penetrations, for several successive blows of the ram; and that this is done with a heavy ram (its weight at least exceeding that of the pile), made to fall from such a height that the force of its blow will not be spent in merely overcoming the inertion of the pile, but at the same time not from so great a height as to generate a force which would expend itself in crushing the fibres of the head of the pile. In such a case it will be found that the pile will safely bear, without danger of further subsidence, "*as many times the weight of the ram, as the distance which the pile is sunk the last blow is contained in the distance which the ram falls in making that blow, divided by eight.*" For example, let us take a practical case, in which the ram weighs one ton and

falls six feet, and in which the pile is sunk half an inch by the last blow; then as half an inch is contained 144 times in 72 inches, the height the ram falls, if we divide 144 by 8, the quotient obtained, 18, gives the number of tons which may be built with perfect safety, in the form of a wall, upon such a pile.—JOHN SANDERS.—*Franklin Journal.*

ENGINEERING AND ARCHITECTURE AT QUEEN'S COLLEGE, BIRMINGHAM.—An important supplemental charter has just been granted by the Crown to the Queen's College at Birmingham, for the furtherance of the studies of engineering and architecture. From this document we extract the following passage:—"And our further will and pleasure is, that in addition to the members of the council as previously constituted by our charter and supplemental charter, two members of the Institution of Mechanical Engineers, two members of the Architectural Society established in Birmingham, and two members of the Law Society established in Birmingham, to be elected by their respective societies previously to the annual general meeting of the governors of the said college, shall be members of the said council. And whereas, subsequently to the granting of the said charter and supplemental charter, an east wing has been erected in the said Queen's College, for the reception of students in the engineering and architectural department, and also lecture-rooms and an engineering workshop: And whereas it is proposed to open the said department of the college forthwith for the reception of students: Our further will and pleasure is, in order to promote those important branches of education, namely—civil engineering and architecture—that students who have completed not less than a three years' course of instruction in the engineering and architectural department of the said college, and have passed to the satisfaction of the examiner or examiners to be appointed by the council of the said college three public examinations, shall be entitled to the academic rank of Civil Engineer in the said college, and receive from the Principal a diploma, under the seal of the said college." Since this grant, Mr. Sands Cox, the Dean of the Faculty, has issued a circular, in which he states that "the object of the council is to form in this great manufacturing and mining district a central museum, subservient to the general purposes of literature and science, and especially to the courses of education in the college in the engineering, mining, and architectural branches;" and names the following particulars, in which material assistance may be rendered to the undertaking. 1st, Donations of money towards the fitting up of the engineering workshop and students' chambers. 2d, Mining, mineral, and chemical products. 3d, Civil engineering, architecture, and building contrivances. 4th, Manufacturing machines and tools. 5th, Patterns, models, plates, books, drawings, philosophical apparatus, diagrams, plastic art. Birmingham's central position, as the industrial capital of an immense tract of country, at once points it out as a most desirable locality for working out such a project, and we consider that we do a public service in giving a place to its claims here.

GOVERNMENT TRIALS OF ANCHORS.—We have to draw the attention of anchor-forgers to the approaching trials of anchors at Sheerness, as an opportunity not to be lost sight of, in showing the standing of their work. The annexed is the Admiralty notice:—"The committee of naval officers and shipowners selected to test the relative properties and merits of ships' anchors having, at a preliminary meeting held at Sheerness, come to the following resolutions, the same are made known for the information of all parties who may be desirous of having anchors tested:—1. That the trials be open to anchors of all nations. 2. That the weight of the anchors for these trials be 25 cwt., including the stock. 3. That every anchor, previously to being allowed to enter into competition, must be tested at Woolwich. 4. That the anchors be landed at Woolwich for testing by the 1st of May next, at Sheerness by the 1st of June, and the trials to commence on the 1st of July next. 5. That the committee will not hold themselves responsible for any loss or damage that may be sustained by the anchors, nor be liable for any expense in bringing them to or taking them from Sheerness. The trials will take place at Sheerness.—J. PARKER."

SIMPSON AND SHIPTON'S ENGINE AND STEAM-PRINTING.—The proprietors of the *Sherborne Journal*, an influential provincial paper, in adopting the steam printing-machine, have selected Messrs. Simpson and Shipton's oscillating short-stroked reciprocating engine to drive it. A late issue of the paper in question says:—"The Great Exhibition afforded us a good choice of engines, and a very beautiful patent, by Messrs. Shipton and Simpson, of Manchester, has been selected; but from various causes (one of which within the last few weeks has been the engineers' strike), we were unable to set our engine at work so soon as we had intended, or had designed. As a proof of the great aid which improved machinery affords to every branch of trade, we may mention that the work which formerly required eight hours of severe labour, is now very easily performed in an hour and a half. The engine is of an entirely novel design—has an oscillating cylinder—eccentric motion, and would come nearly within the compass of an ordinary hat-box." We have already discussed both forms of this ingenious engine at pages 15 and 134, vol. ii., and page 46, vol. iii.

TRANSMISSION OF PRINTED BOOKS BY POST.—All who have had occasion to avail themselves of the late Treasury warrant, authorising the transmission of printed books through the Post-office, must have often felt themselves unduly trammelled by the stringent regulations preventing the enclosure of more than one volume or pamphlet in a single packet, as well as the slightest indorsement on any single page. We have much pleasure, then, in making the announcement, that, from and after the 1st of March, these restrictions are abolished. Any number of separate publications may now be sent at the rate of 6d. per pound as before, and they may have any writing on them short of a regular letter. In effect, the new regulation permits the sending of any quantity of paper, whether printed or not; so that drawings and prints may now be so conveyed with any mounting, carving, or rollers, which may be necessary for safe carriage.

MACHINE-MADE CLOTHING.—All nations present their costumes; but the new costumes, the new head-gear, that the world talked of—where are they? Where is the clothing made without hands, without stitches; the clothing that is to extinguish sempsters, and say to the seamstresses, "Be no more?"—the clothing so cheap, that it may be renewed as the trees their leaves, and the old thrown away, and not sold to Jews, or made to give an unpleasant odour to newly-purchased flowers? Where is all this? Still hang the furlongs of cloth by the walls; still clink the shears that are to cut it up into fragments; still stands the needle-maker plying his fragments of steel wire: still exist the most wretched of God's creatures exulting in false joy for the privilege to make stitches: but we see a French and an American stitching machine working in rivalry, and we hear of the numbers that are used in New York; these, and an unsightly round web of knitted network on a kind of barrel, give a distant hope of the future. But where is the garment of all nations that shall grow up into classic elegance without the mark of the slave thereon? There is little enough of grace or beauty in the barbarian costumes. The lay-figure of modern Greece is as ugly as gold-lace can make it, and is not excelled by Tunis or Eastern India, or any other half-savage country in the want of grace. European costume has grown to an unpleasant commonness, as though the human form were no longer so worthy an object for artist-work as houses and furniture. It may be that the beauty of undressed forms has rendered people careless of costume. But perhaps they are waiting the extinction of stitchery, and the new growth that shall then arise. Yet there is enough of the old and beautiful to regenerate the new and ugly, when artists shall again apply themselves to their legitimate task of draping the human form, and rescue their art from the clutches of the stitching tribes.—HELIX.—*Westminster Review.*

DONISTHORPE'S WOOL-COMBING PATENT.—LISTER *v.* TODD.—(Queen's Bench.)—Mr. Donisthorpe's patent of 1842, for his novel combing machinery, has just been legally established by the result of this trial, which was brought by Mr. Lister, the assignee of the patent, for the recovery of damages for infringement. The defence was the very usual one—not new. The jury, however, thought otherwise, and gave a verdict for the plaintiff.

THE "TIMES" DISC ENGINE.—In speaking of Mr. Bishopp's modification of the disc engine, which, as we have already described,* has worked the machinery in Printing-House Square since 1849, the *Times* characterises it as "the most important advance made in the application of steam to rotatory motion." To many of our readers, whose experiences date from a period anterior to the existence of the notable "Birmingham Disc Engine Company," the "disc" movement will be very familiar. Those who have not already considered its action, may gain some notion of it by spinning a half-crown on a table, and watching the peculiarity of its action when its motion partakes of the series of rapid vibrations, combined with a slow circular movement on its axis, shortly before coming to a state of rest. This, we say, will give an idea of the disc action, although it is, in reality, very different to it—for the disc in the engine does not revolve at all round its own centre. The steam is regulated and admitted in the usual way, through ports with or without expansion valves, and it is brought to bear upon a disc, which supplies the place of a piston in the cylinder. In the centre of this disc is a solid ball, to which the propelling arm or disc shaft is secured. The steam is turned (by a fixed partition in the cylinder) from the induction port round the cylinder to the exhaust port on the other side; the covers of the cylinder being in fact hollow cones, through which the propeller projects. The reciprocating motion given to the disc, as it is pressed against these cones, gives a circular motion to the arm. One end of the propeller turns in a socket set in the side of a solid wheel, at the end of the shaft to be driven, and thus a direct force is applied to a crank, upon which the disc exerts a uniform force. 150 revolutions a minute may be obtained without exceeding a speed on the edge of the disc of 250 feet. The difficulties against which this scheme has had to contend have chiefly had reference to the packing on the working surface. In Messrs. Rennie's engine, recently made for Messrs. Marshall's bleachworks at Hanwood, near Shrewsbury, the surfaces of the cones and disc are quite plain, packing only being required round the periphery. This simplifies the details very much, and the engine in question works well. The theoretical advantages of the disc system are, that the steam pressure acts continuously in a tangent to the circular path of the crank-pin, whilst it has no dead point, and may be driven at any reasonable rate. Messrs. Whitworth have also lately made one for draining a Lincolnshire fen.

COTTON FROM STRAW.—During some experiments lately made in Nottingham, by an amateur chemist of that town, on Claussen's process of making cotton from flax—the operator not having flax straw at hand, tried common oat straw. The result is another of the many instances of "accidental discovery," where pure chance has guided us direct to valuable inventions. After the large proportion of silica and gums contained in straw had been dissolved, a large quantity of good cotton was obtained. What may be the commercial result of this curious matter, it is yet difficult to say; but the discoverer is of opinion that common straw *may* be profitably converted into cotton. It is at any rate worth a well-conducted investigation.

LONDON AND NORTH-WESTERN RAILWAY WORKING STOCK.—The mileage charge for the working stock of this gigantic line, is stated to be £2,436 per mile, 863¼ miles of railway being worked by the company. A recent return shows that there are 582 engines and 575 tenders, 1 state-carriage, 586 first-class mails and composite carriages, 564 second-class, and 344 third-class, 25 post-office tenders, 271 horse-boxes, 249 carriage trucks, 210 guards, break and parcel-vans, 43 trucks, 8,195 waggons, 232 sheep-vans, 15 trucks and carts, 1,155 crib-rails, 5,150 sheets, and 162 horses—the increase in the stock during the half-year being 19 engines, 13 tenders, 31 first-class, and 75 second-class carriages. The total cost of this working stock, including machinery and tools generally, up to the present time, is £2,102,632.

* See page 99, Vol. II., P. M. Journal.

Hay's Preservative Composition for Iron Ships.—The officers of the Portsmouth Dockyard have given conclusive testimony in favour of the value of this invention in a special report on the condition of the *Fairy*. After eight months' wear, the portion treated with this composition is, according to this report, quite clean and in excellent order.

French Railway Traffic.—The traffic receipts on 21 French railways during the year 1851, shows that £4,133,198 had been received on 1,896 miles of railway, being at the rate of £2,179 per English mile; in 1850 the traffic receipts amounted to £3,639,172 on 1,657 miles of railway, being at the rate of £2,196 per mile; and, in 1849, the receipts on 19 railways amounted to £2,719,306 on 1,270 miles, being at the rate of £2,140 per mile. In the year 1842 the receipts on railways in the united kingdom amounted to about £200,000 more than those on the French lines last year, being £4,341,781, and averaging £3,118 per mile. The average receipts per mile on railways in the united kingdom in 1851 amounted to £2,281 per mile, being about £100 per mile more than the receipts on the French lines; but the average cost of the English lines is considerably more than that of the French lines.

Parisian Industry.—Parisian industry produces annually from 14 to 15 hundred millions of francs' worth of goods of various species. There are 325 principal branches of industry, 64,000 patented masters, 342,530 workpeople, of whom 204,000 are men, 112,000 women, and 26,530 children. The first arrondissement, in which the carriage trade is chiefly carried on, produces to the value of 102 millions; the 2d, 177 millions; the 3d employs 32,000 workmen, producing 127 millions; the 4th employs 21,000 workmen, producing 72 millions; the 5th, 51,000, producing 169 millions; the 6th, 68,000, producing 235 millions. The last arrondissement is especially Parisian. This arrondissement produces annually 235 millions' worth of goods out of nothing, but it contributes its genius to the work. It is here that Paris goods are manufactured, fancy turnery, buttons, brushes, canes, umbrellas, jewellery, plated work, lace, and a hundred thousand marvels of ingenuity known and sought after in every part of the world. The 7th numbers 41,000 workmen, and produces 153 millions. It is very nearly related in character to the 6th. The 8th employs 50,000 workmen, and produces 132 millions. This is the quarter for cabinet-making, paper-hanging, carpentery, and brewing. The 9th numbers 15,000 workmen, producing 55 millions. The 10th numbers 20,000 workmen, producing 68 millions. The 11th numbers 19,000 workmen, producing 63 millions. Lastly, the 12th, which is the great quarter for tanners, rag merchants, and brewers, numbers 70,000 workmen, producing 100 millions. In special branches of industry, that of bronze work is unrivalled in the world, producing 20 millions; hatmaking, 16 millions; glovemaking, 14 millions. The wages vary among this immense population of workpeople from 20 centimes (2d.) a-day to from 35f. to 40f. (from 28s. to 32s.) The average wage is 3f. 80c. (3s. 2d.) a-day for a man, and for a woman 1f. 65c. (1s. 4½d.)

ENGLISH PATENTS.

Sealed from 20th January, to 14th February, 1852.

James Aikman, of Paisley, Renfrewshire, calenderer,—"Improvements in the treatment or finishing of textile fabrics and materials."—January 20th.

James Macnee, of Glasgow, merchant,—"Improvements in the manufacture or production of ornamental fabrics."—20th.

Thomas Kennedy, of Kilmarnock, gun-manufacturer,—"Improvements in measuring and registering the flow of water and other fluids."—20th.

Peter Armand Lecomte de Fontainemoreau, of South-street, Finsbury,—"Certain improvements in treating fibrous substances."—(A communication.)—20th.

Henry Graham William Wagstaff, of Bethnal-green, Middlesex, candlemaker,—"Improvements in the manufacture of candles."—20th.

Peter Wright, of Dudley, Worcester, vice and anvil manufacturer,—"Improvements in the manufacture of anvils."—20th.

John Whitehead the younger, of Elton, near Bury, Lancaster, dyer and finisher, and Robert Diggle, of the same place, foreman,—"Improvements in bleaching and dyeing, and in washing, scouring, and other processes connected therewith."—20th.

George Lowe, of Finsbury Circus, London, civil engineer, and Frederick John Evans, of Horseferry-road, Westminster, civil engineer,—"Improvements in the manufacture of gas for the purposes of illumination, and of improvements in the purification of gas, and of improved modes of treating the products arising from the manufacture of gas."—20th.

Frank Clarke Hills, of Deptford, Kent, manufacturing chemist,—"Improvements in manufacturing and purifying certain gases, and in preparing certain substances for purifying the same."—22d.

Peter Armand Lecomte de Fontainemoreau, of South-street, Finsbury, London,—"Certain improvements in railways and locomotive engines, which said improvements are also applicable to every kind of transmission of motion."—(A communication.)—22d.

Edward Tyer, of Queen's-road, Dalston, gentleman,—"Certain improvements in the means of communication by electricity, and apparatus connected therewith."—22d.

James Pillans Wilson and George Fergusson Wilson, of Wandsworth, gentlemen,—"Improvements in the preparation of wool for the manufacture of woollen and other fabrics, and in the process of obtaining materials to be used for that purpose."—22d.

Walter Marr Brydone, of Boston,—"Improvements in apparatus for signal and other lights for railways."—22d.

Thomas Richardson, of Newcastle-upon-Tyne,—"Improvements in the manufacture of magnesia and some of its salts."—23d.

George Stacey, of Uxbridge, Middlesex, machinist,—"Certain improvements in machinery for reaping, mowing, and delivering dry or green crops."—24th.

William Pidding of the Strand, Middlesex, gentleman,—"Improvements in the manufacture, preparation, and combination of materials or substances for the production of fuel, and for other useful purposes to which natural coal can be applied."—24th.

Joseph Jones, of Bilston, Stafford, furnace-builder,—"Improvement or improvements in furnaces used in the manufacture of iron."—24th.

Richard Ford Sturges, of Birmingham, Warwick, manufacturer,—"An improved method or improved methods of ornamenting metallic surfaces."—24th.

John Hinks, of Birmingham, manufacturer, and Eugene Nicolle, of Birmingham aforesaid, civil engineer,—"Certain improved machinery to be used in the manufacture of nails, rivets, bolts, or pins, and screw-blanks."—24th.

Peter Armand Lecomte de Fontainemoreau, of South-street, Finsbury,—"Certain improvements in lithographic, typographic, and other printing presses, which improvements are also applicable, with certain modifications, to extracting saccharine, oleaginous, and other matters, and to compressing in general."—(A communication.)—24th.

James Gathercole, of Eltham, Kent, envelope-manufacturer,—"Improvements in the manufacture and ornamenting of envelopes, parts of which improvements are applicable to other descriptions of stationery; and in the machinery, apparatus, or means to be used therein."—24th.

Arad Woodworth, and Samuel Mower, of Massachusetts, United States,—"Certain new and useful improvements in machinery for manufacturing bricks, tiles, or other articles of a similar character."—24th.

Alfred Richard Corpe, of Kensington, Middlesex, gentleman,—"Improvements in trouser-strap fasteners."—24th.

George Kent, of the Strand,—"Certain improvements in apparatus for sifting cinders, and in apparatus for cleaning knives."—24th.

Joseph Maudslay, of the firm of Maudslay, Sons, and Field, of Lambeth, Surrey, engineers,—"Improvements in steam engines, which are also applicable, wholly or in part, to pumps and other motive machines."—26th.

Edward Simons, of Birmingham, tallow-chandler,—"Certain improvements in lighting."—27th.

William Brindley, of Queenhithe,—"Improvements in the manufacture of flocked fabrics, and in the manufacture of buttons."—27th.

William Dray, of Swan-lane, Upper Thames-street, London, agricultural implement-maker,—"Improvements in reaping machines."—(A communication.)—27th.

George Duncan of the New North-road, Hoxton, and Arthur Hutton, of Herbert-street, New North-road, Hoxton,—"Improvements in the manufacture of casks."—27th.

Nelson Smith, of New York, United States, gentleman,—"Improvements in the construction of violins, and other similar stringed musical instruments."—(A communication.)—27th.

Jean Benjamin Coquatrix, of Lyons, France, merchant,—"Improved apparatus for lubricating machinery."—27th.

James Joseph Brunet, of the Canal Iron-works, Poplar, Middlesex, engineer,—"Certain improved combinations of materials in ship-building."—(A communication.)—27th.

Alexander Mills Dix, of Salford, brewer,—"Certain improvements in the method of ventilating apartments or buildings, and in the apparatus connected therewith."—27th.

Thomas Lambert, of Hampstead-road, Middlesex, piano-forte manufacturer,—"Certain improvements in piano-fortes."—27th.

Julian Bernard, of Guildford-street, Russell-square, Middlesex, gentleman,—"Improvements in the manufacture or production of boots and shoes, and in materials, machinery, and apparatus connected therewith."—27th.

Joseph Vincent Melchior Raymondi, of Paris, France, machinist,—"Certain improved statistic and descriptive maps."—27th.

Isaac Lewis Pulvermacher, of Vienna, engineer,—"Improvements in galvano-electric, magneto-electric, and electro-magnetic apparatus, and in the application thereof to lighting, telegraphic, and motive purposes."—29th.

François Jules Manceaux, of Paris, France, gun-manufacturer,—"Improvements in fire-arms, and in instruments and apparatus used in connection therewith."—29th.

Isham Baggs, of Liverpool-street, Middlesex, electrical engineer,—"Improvements in crushing gold quartz and metallic ores."—29th.

Joseph Maximilian Ritter von Winiwarter, of Surrey-street, Strand, Middlesex, Doctor of Laws,—"Certain improvements in the locks of fire-arms and cannon, and in gun-matches, or in the mode of igniting gunpowder used in guns, and in machinery for manufacturing the same."—29th.

William Smith, of Kettering, Northampton, agricultural implement-maker,—"Improvements in apparatus for cutting or breaking lump sugar, and other vegetable substances."—29th.

Alfred Vincent Newton, of Chancery-lane, Middlesex, mechanical draughtsman,—"Improvements in the manufacture of pigments or paints."—(A communication.)—29th.

Edward Highton, of Clarence-villa, Regent's-park, Middlesex, civil engineer,—"Improvements in electric telegraphs."—29th.

William Longmaid, of Beaumont-square, Middlesex, gentleman,—"Improvements in obtaining gold."—30th.

Owen Williams, of Stratford, Essex, engineer,—"Improvements in preparing compositions to be used in railway and other structures, in substitution of iron, wood, and stone."—(A communication.)—31st.

Charles Cowper, of Southampton-buildings, Chancery-lane, Middlesex,—"Improvements in multiplying motion applicable to steam-engines, saw-mills, and other machinery, in which an increase of velocity is required."—(A communication.)—31st.

Martin John Roberts, of Woodbank, Gerrard's-cross, Bucks, Esq.,—"Improvements in agricultural implements."—31st.

Alexander Hediard, of 25 Rue Tait Bout, Paris, France, gentleman,—"Improvements in propelling and navigating ships, boats, and vessels, by steam and other motive power."—31st.

Joseph Haythorne Reed, late of the 17th Lancers, Harrow-road, Middlesex, gentleman,—"Improvements in propelling vessels."—31st.

Richard Archibald Brooman, of the firm of J. C. Robertson and Company, of Fleet-street, London, patent agents,—"Improvements in the purification and decoloration of oils, and in the apparatus employed therein."—(A communication.)—31st.

William Squire, of High Holborn, late of George-street, Euston-square, both in Middlesex, piano-forte maker,—"Improvements in the construction of piano-fortes."—31st.

Alfred Vincent Newton, of Chancery-lane, Middlesex, mechanical draughtsman,—"Improvements in machinery for weaving coach-lace, Brussels tapestry, and velvet carpeting, and other piled fabrics."—(A communication.)—31st.

Frederick Philip Thompson, of Waterworks-chambers, Orange-street, Trafalgar-square, engineer and surveyor,—"Improvements in filtering and preserving water."—February 2d.

George Spencer, of Lacy-terrace, Islington, engineer,—"Improvements in the springs of railway carriages, trucks, and waggons."—2d.

Samuel Cunliffe Lister and James Ambler, both of Manningham, in the parish of Bradford, York, manufacturers,—"Improvements in preparing and combing wool and other fibrous materials."—2d.

Emanuel Charles Theodore Croutelle, manufacturer, of Rheims,—"Certain improvements in machinery or apparatus for preparing woollen threads and other filaments."—3d.

Robert Hesketh, of Wimpole-street, St. Marylebone, Middlesex,—"Improvements in apparatus for reflecting light into rooms and other parts of buildings and places."—3d.

Peter Claussen, of Gresham-street, London, gentleman,—"Improvements in the manufacture of saline and metallic compounds."—3d.

George Torr, of the Chemical-works, Frimley's-lane, Rotherhithe, animal-charcoal-burner,—"Improvements in reburning animal charcoal."—3d.

John Feather, of Keighley, York, worsted-spinner and manufacturer, and Jeremiah Driver, of the same place, iron and brass founder,—"Certain improvements in screws."—9th.

Auguste Neuberger, of Rue Vivieno, Paris, France, lamp manufacturer,—"Certain improvements in lamps."—9th.

William Beckett Johnson, of Manchester, Lancaster, manager for Messrs. Ormerod and Son, engineers and iron-founders,—"Improvements in railways, and in apparatus for generating steam."—9th.

Sanders Trotman, of Clarendon-road, Middlesex, civil engineer,—"Improvements in fountains."—9th.

John Dennison, of the firm of John Dennison and Son, of Halifax, York, and David Peel, of the same place, manufacturers,—"An improved lubricating compound."—9th.

Ralph Errington Ridley, of Hexham, Northumberland, tanner,—"Improvements in cutting and reaping machines."—9th.

Martin John Roberts, of Woodbank, Gerrard's-cross, Bucks, Esq.,—"Improvements in galvanic batteries, and in obtaining chemical products therefrom."—10th.

John Smith Hutton, of Bolton-le-Moors, Lancaster, bleacher, and Joseph Musgrave, of the same place, engineer,—"A certain improvement or improvements in apparatus used in the bleaching of yarns and goods."—12th.

Christian Schiele, of Oldham, Lancaster, machinist,—"Certain improvements in obtaining and applying motive power."—12th.

William Edward Newton, of Chancery-lane, Middlesex, civil engineer,—"Improvements in heddles or harness of looms for weaving, and in the machinery for producing the same."—(A communication.)—12th.

John Stephens, of Kennington, Surrey, Esq.,—"Improvements in obtaining and applying motive power."—12th.

John Mollady, junior, of Denton, Lancaster, hat-manufacturer,—"Certain improvements in machinery or apparatus for manufacturing hats or caps."—12th.

Charles Louis Barbe, of Mulhouse, France,—"Improvements in the reproducing of drawings, and in the mode of obtaining designs, to be principally used in the engraving surfaces for printing fabrics."—12th.

Annet Gervoy, of Lyons, France, director of the Lyons Railway,—"Means to prolong the durability of the rails on railways."—13th.

Edmund Morewood, of Enfield, Middlesex, and George Rogers, of the same place,—"Improvements in the manufacture, shaping, and coating of metals, and in the means of applying heat."—13th.

Herman Turck, of Broad-street buildings, London, merchant,—"Improvements in the manufacture of rosin-oil."—(A communication.)—14th.

Arthur Wellington Callen, of Peckham, Surrey, gentleman, and John Onions, of Southwark, in the same county, engineer and ironfounder,—"Improvements in the manufacture of certain parts of machinery used in paper-making, and certain parts of railways, railway and other carriages."—14th.

SCOTCH PATENTS.

Sealed from 22d January, to 22d February, 1852.

Nicholas Derode, 37 Rue St. Roch, Paris, France, gentleman,—"A certain process for uniting cast-iron to cast-iron, and to other metals, and for uniting other metals together."—January 26th.

George Torr, Chemical Works, Turnley's-lane, Rotherhithe, animal charcoal burner,—"Improvements in burning animal charcoal."—26th.

James Pillans Wilson, and George Fergusson Wilson, Wandsworth, Surrey, gentlemen,—"Improvements in the preparation of wool for the manufacture of woollen and other fabrics, and in the process of obtaining materials to be used for that purpose."—26th.

Victor Lemoign, Cette, department of l'Herault, France,—"Certain improvements in rotatory engines."—26th.

John Stopporton, Isle of Man, engineer,—"Certain improvements in propelling vessels, parts of which improvements are applicable to steam-engines and pumps."—28th.

Joseph Stenson, of Northampton, engineer and iron manufacturer,—"Improvements in the manufacture of iron, and in the steam apparatus used therein, part or parts of which are also applicable to evaporative and motive purposes."—30th.

John Chatterton, of Birmingham, Warwickshire, agent,—"Certain improvements in protecting insulated electro-telegraphic wires, and in the methods and machinery used for that purpose."—30th.

Sidney Smith, Nottingham,—"Improvements in indicating the height of water in steam-boilers."—4th February.

Francis Clark Monatis, Earlston, Berwickshire, builder,—"An improved hydraulic syphon."—4th.

George Duncan, New North-road, Hoxton, and Arthur Hutton, of the same place,—"Improvements in the manufacture of casks."—6th.

George Collier Halifax, Yorkshire, mechanic,—"Improvements in the manufacture of carpets and other fabrics."—10th.

Alfred Vincent Newton, of the Office for Patents, 66 Chancery-lane, Middlesex, mechanical draughtsman,—"Improvements in the manufacture of pigment or paint."—11th.

Alfred Vincent Newton, of the Office for Patents, 66 Chancery-lane, Middlesex, mechanical draughtsman,—"Improvements in machinery for weaving coach lace, Brussels tapestry and velvet carpeting, and other pile fabrics."—13th.

James Anderson Young, of the firm of A. S. Young & Son, 185 Buchanan-street, Glasgow, Lanarkshire, surgeon-dentist,—"Improvements in dental operation, and in apparatus or instruments to be used therein."—16th.

Charles Cowper, 20 Southampton buildings, Chancery-lane, Middlesex, patent agent,—"Improvements in machinery for combing and preparing wool and other fibrous substances."—13th.

Hermann Turck, Bread-street buildings, London, merchant,—"Improvements in the manufacture of resin oil."—18th.

James Robertson, Oxford-street, Manchester, chemist,—"Improved methods of producing or obtaining printing dyes and other substances, which improvements, in whole or in part, are applicable to other like useful purposes."—20th.

IRISH PATENTS.

Sealed from 21st January, to 19th February, 1852.

Edwin Rose, Manchester, Lancaster, Esq.,—"Certain improvements in boilers for generating steam."—6th February.

Frederick Rosenborg, of the Albany, Middlesex, Esq.,—"Improvements in the manufacture of casks, barrels, and other like articles, and the machinery employed therein."—10th.

John Livesey, New Lenton, Nottingham, draftsman,—"Improvements in the manufacture of textile fabrics, and in machinery for producing the same."—10th.

Alexander Hediard, 25 Rue Taitbout, Paris, gentleman,—"Improvements in propelling and navigating ships, boats, and vessels, by steam and other motive power."—10th.

Charles James Pownall, Addison-road, Middlesex, gentleman,—"Improvements in the preparation and treatment of flax, and other like fibrous vegetable substances."—11th.

DESIGNS FOR ARTICLES OF UTILITY.

Registered from 16th January, to 18th February, 1852.

Jan. 16th, 3084. J. Humphreys, Lancaster,—"Presser-mould."
17th, 3085. T. G. Cressall, Finsbury,—"Steam-lock."
20th, 3086. S. Hood, Upper Thames-street,—"Stable fitting for loose-box."
— 3087. W. Coulson, York,—"Morticing machine."
Jan. 22d, 3088. H. Wilkinson, Pall-mall,—"Self-expanding solid rifle bullet."
— 3089. Stephen Webb, of the firm of Walker and Webb, Oxford-street,—"Kuklosiphon, or fetlock boot."
— 3090. George P. Cooper, Suffolk-street, Pall-mall,—"Elliptic gusset."
28th, 3091. W. C. Wright, South-quay, Regent's-canal Dock,—"Machine for screening coals."
— 3092. Brierley and Son, Cheapside, Halifax,—"Fastening for braces, &c."
29th, 3093. T. Fotherby and Son, Leeds,—"Setting-up brush."
— 3094. J. Shaw, Southover Laves,—"Dried fruit dressing machine."
— 3095. H. A. Hall, Spalding,—"Pump and fire-engine."
30th, 3096. T. H. Ryland, Birmingham,—"Joint for parasol handle."
— 3097. H. Field and Son, Glasgow,—"Domestic gas apparatus."
— 3098. A. Hewlett, Burlington-arcade,—"Caliendrum (wig)."
31st, 3099. T. Woolley, Nottingham,—"Parts of the action of a piano-forte."
Feb. 2d, 3100. J. Bedington, Birmingham,—"Hat and coat guard."
— 3101. J. Jacquier, Wood-street, Spitalfields,—"Jacquard machine."
— 3102. Wolf and Baker, Sambrook-court,—"Revolving fusee-box."
8th, 3103. W. Jefford and S. Turner, New Radford, Nottingham,—"Improvements in twist-lace brass bobbins."
— 3104. S. F. Cottam, Manchester,—"Bearings for spindles of spinning, doubling, and winding machines."
— 3105. T. Smith and Sons, Birmingham,—"Wick-holder and elevator for Argand lamps.
4th, 3106. J. H. Fiedler, Addle-street,—"Traveller's expanding bag."
— 3107. M. Hyams and Co., Long-lane,—"Exhibition cigar."
— 3108. J. Warner and Sons, Jewin-crescent,—"High-pressure valve."
5th, 3109. Westley Richards, Birmingham,—"Rifle sight."
— 3110. Frederick York, Augustus-street, Regent's-park,—"Box-knife, fork and metal cleaning machine."
6th, 3111. John M'Dougall, Kelso,—"Cooking apparatus."
— 3112. Joseph and Thomas Todd, Cannonmills, Edinburgh,—"Expanding cap."
7th, 3113. Edmund Fogden, East Dean, Chichester,—"Manure distributor."
— 3114. John Powell, High-street, Eton,—"Windsor oven."
9th, 3115. W. and C. Kearthland, Mill-street, Lambeth,—"Frame for drying stockings and socks."
10th, 3116. Jameson and Kenworthy, Ashton-under-Lyne,—"Expanding or contracting 'wraith' or comb for sizing, warping, and beaming machines."
— 3117. Kenworthy and Jamieson, Blackburn, Lancashire,—"Spiral expanding and contracting 'wraith' or comb for sizing, warping, and beaming machines."
11th, 3118. A. D. Lamb, Berwick-on-Tweed,—"Gas regulator."
12th, 3119. M. Thomson, Plymouth,—"Telescopic slush and tallow lamp."
— 3120. W. Pink, Fareham,—"Saddle s rap-bar."
13th, 3121. J. C. Bucknill, Exminster,—"B illet mould."
— 3122. C. Smith, A. Smith, and I. Longbottom, Keighley,—"Spool motion for a worsted spinning frame."
14th, 3123. J. Emery, Preston,—"Wicker-work skip with wooden bottom."
— 3124. W. Magcough, Grenville Priest-house, Dublin,—"Apparatus to ascertain the vertical height of clouds."
16th, 3125. Lambert and Co., Portman-street,—"Vertical piano-forte brace."
— 3126. Dunn, Hattersley, and Co., Manchester,—"Railway turn-table, and brake applied thereto."
18th, 3127. W. Muir and H. Goss, Salford,—"Theodolite."
— 3128. W. Gaves and J. Hopkinson, New Wharf-road,—"Smoking tube."

DESIGNS FOR ARTICLES OF UTILITY.

Provisionally Registered from 16th January, to 18th February, 1852.

Jan. 16th, 348. W. D. Richmond, Birmingham,—"Wire, metal, &c., guage."
— 349. J. Worthington, South Shields,—"Parallel ruler."
17th, 350. J. Barker, Birmingham,—"Compensating cabriolet."
— 351. Myers & Son, Birmingham,—"Universal India-rubber holder."
20th, 352. W. Cutlam, North Devon,—"Archimedian chimney-top."
— 353. T. Blissett, Liverpool,—"Anti-Garotte."
22d, 354. George Metcalfe, Algarkirk, near Spalding,—"Steam wheel."
23d, 355. Rose Jacobs, Cockspur-street,—"Lamp or candle shade."
24th, 356. G. F. Philips, Nassau-street,—"Diasometer, for measuring heights, lengths, and widths of objects," &c.
28th, 357. F. H. Elwin, Lincoln's-inn,—"Lath sails."
Feb. 5th, 358. J. G. Wilson, C.E., Lindsay-house, Chelsea,—"Tripod castor."
7th, 359. Ann Hewson, Birmingham,—"Anti-overflow roof-lamp."
— 360. Henry Redsull, Broad-street, Deal,—"Life-boat hook."
12th, 361. W. Mitcheson and Sons, Limehouse,—"Anchor."
14th, 362. J. Manton and Son, Dover-street,—"Caster for bullets or projectiles."
16th, 363. W. H. Lynn, Belfast,—"Impervious casement sill and fastener."
17th, 364. S. Crossby, Cleveland-street,—"Cylinder, or surgical bandage roller."
18th, 365. J. Alderson, Clipstone-street,—"Economical iron joists for floors of fire-proof buildings, with cast-iron braces upon wrought-iron tension."

TO READERS AND CORRESPONDENTS.

Completion of the 4th Volume of *The Practical Mechanic's Journal.*—With the present Part (No. 48), Vols. I., II., III., and IV. are completed, and may be had from any Bookseller, in cloth, lettered, price 14s. each; or the whole 48 Parts separately, for binding to suit the purchaser.—Vols. I. and II., and III. and IV., may also be had, handsomely bound in half-calf, and lettered, to form two double volumes, with the plates bound separately to correspond, either in one or two volumes. Price £1 10s. 6d. for each double volume and volume of plates.—The four volumes contain 1184 pages of letter-press, 92 copperplate engravings, and upwards of 1200 wood engravings.

R. D. wishes to be furnished with "a description of the coil, together with the self-acting apparatus for breaking the current, for a small galvanic battery. Also, the mode of making the connections, and the proper size of wire for the coil."

Piston.—Papin (1683), a native of Blois, in France, and Professor of Mathematics at Marbourg, was certainly the inventor of the cylinder and piston action for steam engines, and therein furnished the earliest idea of that system of mechanical construction, which our own times have seen so wonderfully perfected. Previous to Papin's day, vapour had only been applied in pressing directly upon the surface of water. Papin died, like many other great men, before the world had found out how much he had done for it.

Received.—"Hydraulic Tables." By Nathaniel Beardmore.

J. P. Consett.—We have attended to his request; but the address is so vague, that we have doubts as to his receiving our communication.